REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
September 2002

3. REPORT TYPE AND DATES COVERED
Final

4. TITLE AND SUBTITLE
Dietary Intakes of Female and Male Combat Support Hospital Personnel Subsisting on Meal-Focused or Standard Versions of the Meal, Ready-to-Eat

5. FUNDING NUMBERS

6. AUTHOR(S)
Carol J. Baker-Fulco; F. Matthew Kramer; Larry L. Lesher; Ellen Merrill; Jane Johnson; James DeLany

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760

8. PERFORMING ORGANIZATION REPORT NUMBER
T-02/23

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Research and Materiel Command
Ft. Detrick
Frederick, MD 21702-5012

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release.
Distribution is unlimited.

20021011 068

13. ABSTRACT *(Maximum 200 words)*
This study investigated gender differences in nutrient intake and energy expenditure of combat support hospital personnel during a field training exercise, as well as evaluated a test ration which was slightly higher in carbohydrate and lower in fat than standard MREs and included items being considered for future MREs. Women consumed less energy than men ($p<0.01$) from both the Concept ration (mean ± SD: 2092 ± 570 kcal/d vs. 2678 ± 516 kcal/d for women and men, respectively) and MRE XVII (1818 ± 492 kcal/d vs. 2396 ± 678 kcal/d, respectively). Energy expenditures of the female and male volunteers measured by doubly-labeled water were 2745 ± 87 kcal/d and 3956 ± 243 kcal/d (mean ± SE), respectively, suggesting a significant energy deficit. However, there were no gender difference in energy intakes (31 ± 9 kcal/kg for women vs. 31 ± 10 kcal/kg for men) or energy expenditures (44.9 ± 1.5 kcal/kg for women vs. 45.5 ± 2.3 kcal/kg for men) when normalized to body weight. When intakes of nutrients were normalized for energy intake or body size, there were very few gender differences. Primarily because women consumed less energy than men, greater proportions of women than men ($p<0.01$) failed to meet intake criteria for folate, vitamins B6 and B12, calcium, iron, magnesium, and zinc. The Concept ration did enhance energy and carbohydrate intakes; however, protein intakes in the Concept group were marginally adequate. Thus, the nutrient densities of the field rations tested are not adequate at the levels of energy intake observed in these women (and some men), suggesting that supplementation or further fortification of ration components should be investigated. Efforts to enhance carbohydrate intakes in operational settings will need to ensure that protein intakes are not compromised.

14. SUBJECT TERMS
Diet, dietary intake, consumption, energy expenditure, Meal Ready to Eat, MRE, field feeding, rations, gender, women, nutrition, nutrients

15. NUMBER OF PAGES
82

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to ***stay within the lines*** to meet ***optical scanning requirements.***

Block 1. Agency Use Only *(Leave blank).*

Block 2. Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C	- Contract	**PR**	- Project
G	- Grant	**TA**	- Task
PE	- Program Element	**WU**	- Work Unit Accession No.

Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

Block 9. Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

Block 10. Sponsoring/Monitoring Agency Report Number. *(If known)*

Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of ...; To be published in.... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

Block 12a. Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

DOD - See DoDD 5230.24, "Distribution Statements on Technical Documents."
DOE - See authorities.
NASA - See Handbook NHB 2200.2.
NTIS - Leave blank.

Block 12b. Distribution Code.

DOD - Leave blank.
DOE - Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.
NASA - Leave Blank.
NTIS - Leave Blank.

Block 13. Abstract. Include a brief *(Maximum 200 words)* factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

Block 15. Number of Pages. Enter the total number of pages.

Block 16. Price Code. Enter appropriate price code *(NTIS only).*

Blocks 17.-19. Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

U.S. ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE

TECHNICAL REPORT NO.
DATE
AD

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

U.S. ARMY MEDICAL RESEARCH AND MATERIEL COMMAND

USARIEM TECHNICAL REPORT T-02/23

Dietary Intakes of Female and Male Combat Support Hospital Personnel Subsisting on Meal-Focused or Standard Versions of the Meal, Ready-to-Eat

Carol J. Baker-Fulco
Military Nutrition Division
U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760

F. Matt Kramer and Jane Johnson
Science and Technology Directorate
U.S. Army Natick Research, Development, and Engineering Center
Soldier and Biological Chemical Command
Natick, MA 01760

Larry L. Lesher and Ellen Merrill
GEO-CENTERS, INC.
Natick, MA 01760

James DeLany
Pennington Biomedical Research Center
Louisiana State University
Baton Rouge, LA 70808

September 2002

U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760-5007

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

We are indebted to the following data collectors who were at the training site everyday before sunrise: Ms. Ann Curran, Dr. Cees DeGraf, Ms. Barbara Eberhardt, Ms. Christina Falco, Ms. April Hebert, Ms. Jane Johnson, Ms. Susan McGraw, Ms. Janine Monarrez, Ms. Fatemah Ramezanzade, MAJ Jean Robertson, Ms. Shivaun Roach, Ms. Ruth Roth, and Ms. Karen Speckman. Their expertise and dedication to the study effort are greatly appreciated.

A special appreciation goes to Ms. Barbara Daley and, now, CW4 Suzanne Farrell for assistance with study planning and preparation, as well as data collection. A heartfelt thanks goes to MAJ Stephen "Sam" Slade for also assisting with planning and data collection, as well as providing much needed moral support during the grueling field study.

A special thanks goes to Dr. Catherine Champagne and Dr. Ray Allen of the Pennington Biomedical Research Center for sharing USDA food composition data from Moore's Extended Nutrient (MENu) database and for their coordination of and assistance with the painstaking tasks of dietary data entry and verification.

This ration test generated mounds of dietary intake data, which could not have efficiently undergone data entry and correction at the study site without the committed support of Mr. Troy Fontinault, Mr. Eric LeBlanc, Ms. Regina Louviere, Ms. Kelly Patrick, and Mr. Allen Pesch, who were generously provided by Pennington Biomedical Research Center. In addition, questionnaire data entry and data management would have been impossible without the support of Ms. Susan McGraw and Mr. Phil Niro of the Military Nutrition Division.

The authors gratefully acknowledge the invaluable input of Ms. Doris Sherman, who provided verified nutrient data for many of the MRE ration components and arranged for the nutrient analysis of the crackers.

We are also grateful to Mr. Christopher Amendola, Mr. Bill Glover and, especially, Mr. William Tharion for their handling of the isotope sample collection and processing for shipment.

We respectfully recognize the support and sacrifice of SGT Joseph Racine who expertly coordinated the logistical support of this study, as well as personally, along with SSG Eldret Parrish and Mr. Brian Thorpe, transported supplies and equipment to and from the study site.

We are most grateful to LTC Philip Volpe and the test volunteers from the 28 CSH for allowing such an intrusion into the hectic schedule of a field training exercise. Without their support and cooperation, this project would not have been successful.

EXECUTIVE SUMMARY

Operational rations are designed with dietary allowance levels of nutrients in an energy provision of no less than 3600 kcal. Because women usually require and, therefore, consume less energy than men, the nutrient density (i.e., the nutrient-to-energy ratio) of field rations may not adequately provide for the nutrient needs of many women. This study investigated gender differences in nutrient intakes and energy expenditures of soldiers in an operational setting to determine if the MRE ration adequately meets the dietary needs of women. This study also tested a new concept ration consisting of specific breakfast, lunch, and dinner menus which were slightly higher in carbohydrate and lower in fat than standard MREs and included items being considered for future menus.

The test volunteers were members of the 28th Combat Support Hospital, plus supporting detachments, engaged in an 11-day field training exercise (FTX). Volunteers were stratified by gender and randomly assigned to one of two ration groups. One group was allowed to select a breakfast, lunch, and dinner menu from the meal-focused, Concept ration, while the other group selected three meals per day from MRE XVII. Subjects recorded dietary intakes during the last 7 days of the FTX; 26 women and 26 men in the Concept group and 28 women and 82 men in the MRE XVII group provided complete dietary data for at least 5 days during this time period. Energy expenditures were measured in 17 women and 9 men by doubly-labeled water over the 11-day field training exercise.

Men consumed more energy than women ($p<0.01$) from both the Concept (mean ± SD: 2678 ± 516 kcal/d vs. 2092 ± 570 kcal/d, respectively) and MRE XVII (2396 ± 678 kcal/d vs. 1818 ± 492 kcal/d, respectively)rations. Energy expenditures of the female and male volunteers were 2745 ± 87 kcal/d and 3956 ± 243 kcal/d, (mean ± SE) respectively, suggesting a significant energy deficit. There were, however, no gender differences in energy intakes (31 ± 9 kcal/kg for women vs. 31 ± 10 kcal/kg for men) or energy expenditures (44.9 ± 1.5 kcal/kg for women vs. 45.5 ± 2.3 kcal/kg for men) when normalized to body weight. When nutrient intakes were normalized for energy intake or body size, very few gender differences remained. Primarily because women consumed less energy than men, greater proportions of women than men ($p<0.01$) failed to meet recommended intake criteria for folate, vitamins B_6 and B_{12}, calcium, iron, magnesium, and zinc. Thus, the nutrient densities of the field rations tested are not adequate at the levels of energy intake observed in these women (and some men). These results suggest that supplementation or fortification of military ration components should be investigated.

The concepts tested in the Concept ration (specific breakfast, lunch, and dinner menus, as well as new easy-to-eat items) did enhance energy and carbohydrate intakes as intended. However, protein intakes in the Concept group were marginally adequate. Efforts to enhance carbohydrate intakes in operational settings will need to ensure that protein intakes are not compromised.

INTRODUCTION

Combat service support units are increasingly being deployed on humanitarian and peacekeeping missions. Logistical support to these units often results in subsistence solely on Meals, Ready-to-Eat (MREs) for for the maximum-allowed 21 days. Under some situations, units may continue to rely on MREs as the major source of subsistance because centrally-prepared, hot meals cannot be provided. Many combat service support units, in addition to conducting their own field training exercises, support the field training exercises of combat units. Because of this, personnel may accrue two to four months a year in the field subsisting on operational rations (personal communication, 28 CSH personnel and MND dietitians).

Soldiers typically do not consume sufficient quantities of rations to meet their energy requirements in the field and, as a result, lose weight and risk decrements to their health and physical and cognitive performance (1). The more rapid the weight loss or the longer the period of deficit, the greater the health and performance consequences (24). Perhaps of more concern than an energy deficit is the low carbohydrate intake observed during nutrition field studies (1). The body can rely on fat stores to replace most of an energy deficit, but body carbohydrate stores—muscle and liver glycogen— are limited and must be replaced on a daily basis. Failure to restore muscle and liver glycogen stores may result in fatigue and disorientation and may increase the risk of injury (35).

Dislike of, or boredom with the ration is just one of the many reasons for underconsumption. Current versions of the MRE comprise 24 menus (the version tested in the study described in this report comprised 20 menus), all of which are based on a dinner-type entree. Field tests and user surveys of operational rations have consistently indicated a demand for menus more acceptable for breakfast and for more "eat-on-the-go foods," which can be snacked on during the day when troops are not able to stop for long periods of time to eat a meal. Based on soldier requests for these specific foods, and in addition to the nutritional goal of enhancing carbohydrate and energy intakes, the ration developers at the Natick Soldier Center explored a new "concept" for the MRE. The new concept ration consisted of specific breakfast, lunch, and dinner menus that were slightly higher in carbohydrate and lower in fat than standard MREs and included commercial items then being considered for future MRE menus. This new concept was field tested with Army Rangers and found to enhance dietary intakes of energy and carbohydrate, as well as calcium (Warber, unpublished data). However, acceptability and consumption of these new concept items may differ in men with levels of physical activity different than Rangers or in women.

Women constitute approximately 14% of total active duty military personnel. About 25% of reserve forces are women. There exists only limited restrictions for women on military jobs, with the exception of assignment to units below the brigade

level whose primary missions are to engage in direct combat. Large numbers of women are assigned to combat service support units and make up a significant proportion of the personnel deployed on field training exercises or missions.

Individual MREs (single meals) are designed to contain, on average, one-third of the Nutritional Standard for Operational Rations (NSOR). Because of different food sources of nutrients and selective fortification of items, nutrients are not evenly distributed within the ration. Therefore, to achieve recommended intakes of protein, vitamins, and minerals, individuals must consume all components from three MREs each day. Recent versions of the MRE provide an average of almost 1300 kcal per meal. Given that most women do not need three MREs per day to meet their energy requirements and that many women (and male soldiers) try to lose weight during field exercises, it is likely that female soldiers, especially, fail to consume recommended amounts of many micronutrients

Few studies have addressed how well military feeding policy meets the nutritional requirements of women. Two studies that included women— one with a reserve medical unit in a hot environment (30), the other with an engineer battalion at high altitude (12) — found average intakes of folate, vitamin B_6, iron, calcium, magnesium, and zinc to be less than recommended allowances. Ration provision during these field studies was two hot meals, consisting of mostly B-rations, and one MRE. Only one study (Hirsch, unpublished, August 1995) has assessed dietary intakes and selection patterns of servicewomen subsisting solely on MREs. Unfortunately, this test lasted only 4 days and included only 19 female volunteers. This 4-day test in a hot-dry environment found mean intakes of the women subsisting on the standard MRE to average less than the Military Recommended Dietary Allowance (MRDA) for folate, vitamin B_{12}, iron, calcium, magnesium, and zinc. Based on maintenance of body weight, energy intakes of these women were adequate without being excessive, suggesting that the nutrient density of these nutrients in the ration was inadequate for women.

The primary determinant of ration requirements of women is their total energy expenditure. This parameter prescribes the energy provision and the resulting nutrient densities required for women to meet their micronutrient needs without overconsuming calories. There are no data on energy requirements of military women, in garrison or in the field, upon which to base nutrient density recommendations.

Most nutrition field studies have been with special operations or combat units that may have had different levels of physical activity and different situational factors that affected ration consumption than that of combat support or combat service support units. Importantly, the current study assessed the nutritional issues of members of a combat service support unit which included a large number of female personnel. This study occurred during the field training exercise of a combat support hospital. The

primary purpose of the study was to investigate gender differences in food selection, nutrient intake, and energy expenditure. A secondary purpose of the study was to assess the effects of a meal-focused concept of the Meal, Ready-to-Eat on food selection and nutrient intake.

METHODS

STUDY POPULATION AND SETTING

The test volunteers were members of the 28th Combat Support Hospital, plus supporting veterinarian, dental, and combat stress detachments from Fort Bragg, NC. The study period for dietary assessment consisted of the last 7 days of an 11-day field training exercise (FTX) during which hospital personnel underwent mass casualty drills, reacted to simulated artillery and chemical weapons attacks, conducted perimeter defense, and disassembled the hospital. The test was conducted in early May at Camp Mackall, NC, in temperate conditions.

A total of 230 individuals volunteered for at least the food intake aspects of the study. The number of subjects for different data collection efforts varied due to availability, agreement to participate and compliance. Volunteers recruited before the unit moved to the field were stratified by gender and randomly assigned to one of two ration groups. One group received the then current version of the MRE (MRE XVII), and the other group received a meal-focused, test ration, called the Concept ration. Seventeen women and ten men provided energy expenditure data.

Most of the professional staff and detachment members joined the field training exercise after the first day and were not available for recruitment before the field training exercise. Volunteers recruited at the field site were alternately assigned to the two test groups until 35 men and 35 women were in the Concept ration group. (There were only enough Concept rations to feed 70 individuals for the study period. This number had been determined by power analysis to be adequate to detect a 150 kcal difference in energy intake between groups [5].) All subsequent volunteers were placed in the MRE XVII group. A disproportionate number of subjects were recruited for the MRE XVII group to support the research requirements of Natick to gather ample acceptability data on what was then the most current, fielded MRE. All hedonic rating data captured were provided to the ration developers at Natick.

RATIONS

One ration test group, the MRE XVII group, consumed the most recently procured version of the MRE (MRE XVII). The MRE XVII menus are presented in Appendix A. Appendix B contains the nutrient composition values of the MRE items used to calculate the dietary intakes for this study. MRE XVII comprised 20 menus,

based on different entrées, 18 of which were available from the Defense Supply Center Philadelphia for this study. The energy nutrient breakdown of the average MRE XVII ration as planned was 50% carbohydrate, 13% protein, and 37 % fat. The average MRE provided for use during this study was 53% carbohydrate, 12% protein, and 35% fat. Shelf-stable bread (often termed "pouch bread") was shipped with the MRE XVII rations in quantities sufficient for one bread per MRE. This bread provision resulted in an approximately 540 kcal greater daily energy provision to the MRE XVII group than to the Concept group.

The second test group, the new Concept group, consumed developmental menus designed to test a meal focus (i.e., breakfast, lunch and dinner menus) and a variety of eat-on-the-go snack-type foods, especially as part of the lunch menu. The Concept "ration" tested in this study consisted of 5 specific breakfast meals, 5 lunch menus and 5 dinners. (See Appendix A.) The menus contained food items intended to improve the acceptability of the ration, carbohydrate intakes, and the nutrient status of soldiers consuming the MRE. The test menus were planned to be relatively high in carbohydrate (60% of kilocalories [kcal]), low in fat (under 30% of kcal) and moderate in protein (10% of kcal). The Concept foods and menus compiled for this test were not a finished ration system and were, therefore, not specifically designed to be nutritionally complete. The test Concept rations were assembled at the Natick Soldier Center from items currently in the MRE or proposed for future MREs. Some items were purchased commercially (either directly from the manufacturer or at a local supermarket) or were produced and packaged at the Natick Soldier Center.

Soldiers were provided 3 MREs or Concept ration meals per day for the 7 consecutive days of the field test. Subjects were instructed to not trade items with individuals in the other ration group. In addition, subjects were asked to eat only food provided by the study team; however, the investigators could not enforce this request. Bulk beverages and hot water, typically available to CSH personnel in the field, were allowed.

DESCRIPTIVE MEASUREMENTS

A 37-item background questionnaire was administered upon enrollment into the study to capture demographic and field experience information. One hundred ninety nine volunteers (127 men and 72 women) returned completed questionnaires, although not all subjects who provided usable dietary data for the ration test provided background questionnaires.

The unit could not support the study request that subjects be weighed on the first morning of the 7-day study period. Body weight and height measurements were obtained from 134 volunteers during the unit's deployment readiness processing 3 days before the FTX . Because the professional staff and detachment members were not available at this time, weight and height information for these volunteers were taken

from the post-study measurement or, if a final measurement was not available, the background questionnaire if completed. Body weights were again obtained on the morning after the last day of food intake data collection for subjects still at the field site. Many unit personnel left the FTX earlier than anticipated and were not available for final measures.

Body weights were measured to the nearest 0.25 lb using a calibrated, electronic, battery-powered scale (e.g., Model 6800, Cardinal Detecto). Wooden boards were used to level the scales in the field. Baseline body weights were measured in the morning prior to consuming the first meal of the day. Ending body weights were taken in the morning, but some subjects had already eaten when they reported to the study team. The unit could not support the study request to have subjects report in the PT uniform and have sufficient time to remove shoes or boots. Subjects removed helmets, equipment belts, weapons, and items from their pockets before being weighed. Measured body weights were grossly adjusted for remaining clothing items by subtracting 5 lb for women and 7 lb for men. Standing height was measured using an anthropometer (Seritex, Inc., Carlstadt, NJ) with volunteers in boots and standing on a flat surface, feet together, knees straight, and the head positioned in the Frankfort plane. Heights were grossly adjusted by subtracting 1 inch from the converted centimeter height.

ENERGY EXPENDITURE

Energy expenditures over the 11-day field training exercise were measured in 17 women and 9 men by the doubly-labeled water (DLW) method. This method is based upon the assumption that after a loading dose of the stable isotopes of hydrogen (deuterium) and oxygen ($^{2}H_2{}^{18}O$), ^{18}O is eliminated from the body as water and exhaled as carbon dioxide (CO_2), whereas the deuterium is eliminated only as water. The rate of CO_2 production and hence energy expenditure can be calculated from the difference of the two elimination rates (32). A detailed account of this methodology can be found in the publication by DeLany et al. (9). The oxygen and hydrogen isotope abundances were measured on a Finnigan MAT 252 gas-inlet Isotope Ratio Mass Spectrometer as previously described (9). Changes in baseline isotopic levels were monitored in one female and one male participant who did not receive DLW.

Test subjects consumed the DLW 3 days prior to the start of the FTX. Subjects received 0.22 g/kg estimated total body water of $H_2{}^{18}O$ (Isotec, Miamisburg, OH) and 0.16 g/kg estimated total body water of $^{2}H_2O$ (Cambridge Isotope, Andover, MA). Total body water was estimated as 0.6 times measured total body weight. Calculations of energy expenditure for the FTX period are based on the differences in enrichments of the urine samples obtained on approximately the first morning and the morning after the last day of the FTX. The energy expenditure measurements encompass the entire 11-day FTX period during which occurred the 7-day ration test described in this report. The 4-day period before the ration test involved set up of the field hospital.

DIETARY ANALYSES

Food and fluid intake data were self-reported on preprinted food records which were returned daily and reviewed by dietary data collectors. Subjects circled the amounts of ration items consumed (¼, ½, ¾, all), or annotated the number if more than one portion was consumed. They described any non-ration items consumed and recorded the quantities of bulk beverages consumed in number of canteens, canteen cups, or paper cups. Subjects also rated the ration items as to how well they liked them using a 9-point hedonic scale.

The dietary intake data were entered into computer files using software developed by the Pennington Biomedical Research Center. The nutrient composition data for ration items were obtained from mean laboratory determinations; manufacturer's data; the USDA Nutrient Data Base for Individual Food Intake Surveys, 1994 release; or the USDA Nutrient Database for Standard Reference, release 11. The folate values for items newly fortified with folate were adjusted based on the respective product specification. Nutrient data for non-ration foods and beverages also were obtained from corresponding items in the USDA data bases. Nutrients with missing values for more than a very few foods were not analyzed. Nutrient intake calculations used the actual gram weights of items procured for the study rather than the value used for menu planning by the ration developers. Nutrient intake calculations were performed with SPSS for Windows (1998).

Subjects with less than 5 days of complete food record data were excluded from final analyses. Five was specified, *a priori,* as the minimum number of days to estimate average dietary intakes.

STATISTICAL ANALYSES

Data reduction and analyses were completed using the Statistical Package for the Social Sciences (SPSS) release 8 for the PC. Initially, multivariate analysis of variance (MANOVA) and multivariate analysis of covariance (MANCOVA), with energy as the covariant, were used to determine if there were significant differences in nutrient intakes between ration groups and genders and whether there were significant interactions between ration group and gender. Because the MANOVA and MANCOVA were significant and interaction was present, subsequent comparisons of men and women within each ration group and of ration groups within each gender group were made by one-way MANOVAs and MANCOVAs, with gender or ration as the main factors. Identification of which nutrient intakes were significantly different was determined by univariate comparisons generated by the MANOVA and MANCOVA. All testing was done at $p<.05$ level of statistical significance. Although conservative interpretation of the individual nutrient statistics would only reject the null hypotheses of no difference between means with a p value less than .002 to account for multiple

comparisons of all analyzed nutrients, we felt that no further adjustment of the individual p values was mandated once the MANOVAs indicated the groups were not the same.

RESULTS

A total of 68 subjects were dropped from the study. Twelve test volunteers voluntarily dropped from the study for personal reasons. Three test volunteers left the FTX on emergency leave, three dropped because of illness, and four returned to the rear as part of the exercise or for administrative reasons. Most of the volunteers from the support detachments returned to the rear 1 day earlier than anticipated, which reduced their days of participation to less than 5. The remaining subjects were dropped because of incomplete or unverifiable data, resulting in less than 5 days of complete data, or because of noncompliance with ration group assignment. Data for these subjects are not presented.

One hundred sixty two subjects, 54 women and 108 men, provided complete intake data for at least 5 days. Data from 28 women and 82 men in the MRE XVII group and 26 women and 26 men in the Concept ration group were used in the final dietary intake analyses presented in this report.

SUBJECT CHARACTERISTICS

Tables 1 and 2 summarize the rank structure breakdowns of the combined study population and the two ration groups by men and women. Of the final test population, 26% were officers; however, a greater proportion of female subjects than male subjects were officers—37% and 20%, respectively—and only one of the male subjects in the Concept ration group was an officer.

Table 1. Rank Structure of Subjects Providing Adequate Food Record Data.

Enlisted		Officer	
Total	**120**	Total	**42**
E1	1	O1	5
E2	5	O2	5
E3	12	O3	16
E4	34	O4	10
E5	33	O5	6
E6	27		
E7	6		
E8	1		
E9	1		

Table 2. Rank Structure by Ration Group and Gender.

	Enlisted	Officer
Concept	**40**	**12**
Men	25	1
Women	15	11
MRE XVII	**80**	**30**
Men	61	21
Women	19	9

The men were 29.6 ± 6.4 (mean ± SD) years old, 70 ± 2.9 inches tall, and 177 ± 25.2 lb. Body mass index (BMI) of the men ranged from 19.2 to 35.2 (mean 25.4 ± 2.98). The women were 30.3 ± 7.7 years old, 64.2 ± 2.95 inches tall, and weighed 137 ± 18.8 lb. The BMIs of the women were 18.7 to 40.0 with a mean of 23.5 ± 3.75.

Of the 144 individuals completing a background questionnaire, 53 (37%) stated they wanted to lose weight. The proportion of women who wanted to lose weight (48%) tended to be greater than that for the men (31%). However, only 10% of both men and women stated they were actually trying to lose weight at the time of the study. Only 4 women (8.5%) wanted to gain weight, while 25 men (26%) wanted to gain.

There were no differences in measured body weight losses between women and men or between the ration groups. Both pre- and post-body weight measurements were available on 28 women. The mean weight loss of these women was 0.5 ± 1.3 kg over the entire FTX period. Of the 74 men with both pre- and post-body weight measurements, mean weight loss during the FTX was 1.2 ± 1.5 kg.

Thirty percent of all subjects smoked or chewed tobacco. A greater proportion of the men than women were tobacco users (35% and 20%, respectively). There were no differences in the proportions of male or female tobacco users between ration groups.

OVERALL COMPARISONS

Results of the two-way MANOVA indicate that mean dietary intakes of men and women differed, and intakes of subjects in the two ration groups differed. In addition, interaction between gender and ration group was present. When the influence of total energy intake is accounted for by MANCOVA, with energy as the covariate, these overall differences remain significant. Differences between women and men within ration group and between ration groups within each gender were subsequently evaluated by one-way MANOVAs and MANCOVAs (again, with energy as the covariate). The one-way MANOVAs within each ration group indicate that nutrient intakes of women and men were different in both ration groups (see Table 3). The one-way MANOVAs for the effect of ration on nutrient intakes of women and men indicate that intakes of both women or men were influenced by the ration they consumed. Tables 7 and 8 starting on page 17 present nutrient intakes organized by ration group within gender and the levels of significance for the differences in nutrient intakes within each gender.

Table 3 presents energy and nutrient intakes of women and men in each ration group and the level of significance for the gender comparisons within each ration group. As seen in Table 3, the analyses of covariance reveals there were no differences in nutrient intakes between women and men in the Concept group that could not be at least partially accounted for by energy intake.

Table 3. Daily Energy and Nutrient Intakes by Ration and Gender.
(mean ± standard deviation)

	Concept				MRE XVII			
	Women *(n=26)*[1]	**Men** *(n=26)*[1]	ANOVA[2] *(p)*	ANCOVA[2] *(p)*	**Women** *(n=28)*	**Men** *(n=82)*	ANOVA[2] *(p)*	ANCOVA[2] *(p)*
Multivariate Analyses			.009	.056			.002	≤.0001
Energy, Kcal	2093 ± 570	2688 ± 517	≤.0001		1834 ± 500	2427 ± 690	≤.0001	
Kcal/kg body weight	33.1 ± 10.1	33.6 ± 8.1	ns	—	29.1 ± 8.4	30.9 ± 10.4	ns	—
Carbohydrate, g	325 ± 102	418 ± 90.3	.001	ns	272 ± 90.0	330 ± 105	.010	.003
Carbohydrate/kg BW	5.2 ± 1.86	5.2 ± 1.41	ns	ns	4.3 ± 1.46	4.2 ± 1.52	ns	ns
Protein, g	54 ± 14	68 ± 14	.001	ns	59 ± 17	83 ± 21	≤.0001	.004
Protein/kg BW	0.87 ± 0.27	0.87 ± 0.19	ns	ns	0.94 ± 0.32	1.06 ± 0.34	ns	ns
Fat, g	68 ± 21	86 ± 17	.001	ns	60 ± 18	90 ± 30	≤.0001	.010
Cholesterol, mg	105 ± 66	188 ± 119	.003	ns	122 ± 44	191 ± 54	≤.0001	≤.0001
Dietary Fiber, g	11.2 ± 4.2	13.4 ± 3.6	.045	ns	13.5 ± 4.7	16.1 ± 5.7	.037	.036
VITAMINS								
Vitamin A (μg RE)[3]	789 ± 520	766 ± 318	ns	ns	1000 ± 555	1295 ± 709	.048	ns
Thiamin (mg)	2.5 ± 1.0	2.8 ± 0.9	ns	ns	2.2 ± 1.1	3.0 ± 1.5	.005	ns
Riboflavin (mg)	1.8 ± 0.6	2.1 ± 0.5	ns	ns	1.4 ± 0.5	1.9 ± 0.6	.001	ns
Niacin (mg)	22.0 ± 5.4	25.8 ± 5.7	.015	ns	20.2 ± 6.2	27.6 ± 8.0	≤.0001	ns
Folate (μg)	243 ± 89	310 ± 88	.009	ns	147 ± 54	180 ± 56	.008	ns
Vitamin B_6 (mg)	1.8 ± 0.68	1.9 ± 0.64	ns	ns	2.3 ± 1.13	3.2 ± 1.60	.005	ns
Vitamin B_{12} (μg)	1.74 ± 1.06	1.9 ± 0.67	ns	ns	2.3 ± 1.0	3.2 ± 0.9	≤.0001	.013
Vitamin C (mg)	224 ± 141	344 ± 138	.003	ns	212 ± 113	224 ± 120	ns	.010
Vitamin E (mg αTE)[4]	5.8 ± 2.0	6.3 ± 2.0	ns	ns	13.1 ± 6.9	14.2 ± 6.2	ns	.012

(Continued)

Table 3. Daily Energy and Nutrient Intakes by Ration and Gender. (Continued)
(mean ± standard deviation)

	Concept				MRE XVII			
	Women *(n=26)*[1]	**Men** *(n=26)*[1]	ANOVA[2] *(p)*	ANCOVA[2] *(p)*	**Women** *(n=28)*	**Men** *(n=82)*	ANOVA[2] *(p)*	ANCOVA[2] *(p)*
MINERALS								
Calcium, mg	540 ± 284	695 ± 232	.036	ns	458 ± 163	606 ± 221	.001	ns
Iron, mg	14.2 ± 4.6	15.9 ± 3.2	ns	ns	11.9 ± 3.4	15.6 ± 4.5	≤.0001	ns
Magnesium, mg	217 ± 68	275 ± 74	.005	ns	206 ± 61	280 ± 98	≤.0001	ns
Potassium, mg	1681 ± 576	2007 ± 684	ns	ns	1789 ± 521	2213 ± 668	.003	ns
Sodium, mg	3326 ± 1040	4327 ± 929	.001	ns	3283 ± 799	4425 ± 1171	≤.0001	.031
Sodium, mg/1000 kcal	1591 ± 369	1625 ± 275	ns	ns	1793 ± 268	1807 ± 305	ns	ns
Zinc, mg	6.4 ± 1.9	7.1 ± 1.5	ns	ns	8.1 ± 2.6	11.8 ± 3.1	≤.0001	.001

[1] Nutrients per kg calculated for subjects with body weight data. Body weight data available on 24 women in the Concept ration group, 25 men in the Concept group, 25 women in the MRE XVII group, and 72 men in the MRE XVII ration group.

[2] The levels of significance of the difference between cell means for individual nutrients are from univariate analyses of variance generated by the one-way MANOVAs by gender within each ration group. One-way MANOVAs were performed following the findings of significant group, gender, and interaction effects in the two-way MANOVA.

[3] Unit of measure is microgram Retinol Equivalent.

[4] Unit of measure is alpha Tocopherol Equivalent.

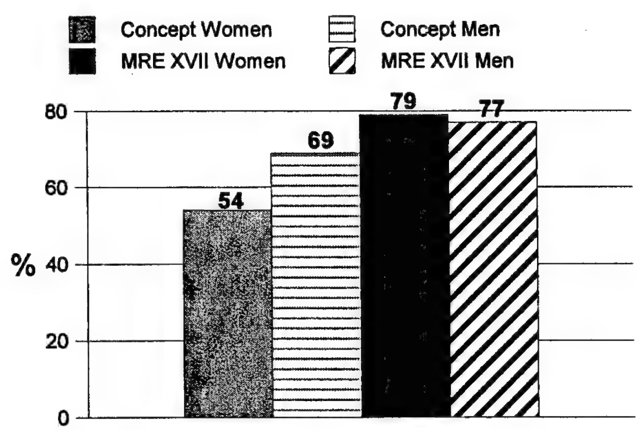
ENERGY INTAKE

Mean energy intakes of both men and women, regardless of ration group, were below their energy Military Dietary Reference Intakes (MDRIs) for moderate activity; however, there were large ranges of individual intakes. As expected, absolute mean energy intakes of women were significantly less than men ($p \leq .0001$). The mean energy intake of women providing complete food record data for at least 5 days was 1959 ± 545 kcal per day, with a range of mean daily intakes from 720 to 2974 kcal. Men consumed, on average, 2490 ± 661 kcal per day. Mean daily energy intakes for men ranged from 1112 to 4124 kcal. One female subject (in the Concept group) and three male subjects (all in the MRE XVII group) had verbally corroborated zero energy intakes on a study day. Four women and one man had mean daily energy intakes less than 1200 kcal, while nine women and nine men reported energy intakes of less than 1500 kcal per day. Twenty men reported mean energy intakes of less than 2000 kcal per day.

Despite a much higher energy provision to the MRE XVII ration group, the mean energy intake of men receiving the Concept ration (2688 ± 517 kcal/d) was higher ($p=.05$) than that of those consuming the MRE XVII ration (2427 ± 690 kcal/d). Mean energy intake of women subsisting on the Concept ration (2093 ± 570 kcal/d) was not significantly different ($p=.057$) from that of women in the MRE XVII group (1834 ±500 kcal/d), although this difference likely would have been significant had the group sizes been larger.

Figure 1 illustrates the number of individuals reportedly consuming less energy than the gender specific MDRI for light activity (i.e., less than 2200 kcal for women and less than 3000 kcal for men). There was a high prevalence of reported low energy intakes in both ration groups; however, there were greater proportions of women and men subsisting on the MRE XVII ration who failed to reach these conservative goals.

Figure 1. Proportion of subjects consuming less than the minimal energy MDRI



When energy intakes are based on individual body weights, there are no differences in the mean energy intakes of women and men in the same ration group (see Table 3), and there are no statistically significant differences in energy intakes between ration groups within female or male subjects (Tables 8 and 9). Energy intakes

at these levels (30.9 ± 1.4 kcal/kg/day for women and 32.1 ± 1.1 kcal/kg/day for men) would be adequate only if physical activity levels are sedentary.

Table 4 presents the number and proportion of subjects in each ration and gender group with energy intakes at various levels. Acknowledging that self-reported food intakes are often under-reported, these distributions still illustrate the high prevalence of underconsumption. There was a disturbingly high prevalence of reported energy intakes at levels of sedentary or resting energy needs, especially within the MRE XVII group. In general, there were larger proportions of women and men in the Concept group than in the MRE XVII group with energy intakes at levels likely approximating needs (i.e., sufficient to support light to heavy levels of physical activity).

Table 4. Proportion[1] of Subjects with Reported Energy Intakes at Levels Supporting Varying Activity Levels.[2]

	Energy/kg body weight				
Women	**<24**	**24-32.5**	**32.6-36**	**36.1-40.5**	**>40.5**
Men	**<25**	**25-34.5**	**34.6-39.5**	**39.6-45.5**	**>45.5**
Level of Activity Supported	Resting	Sedentary	Light	Moderate	Heavy
Concept Women	4 (15%)	7 (27%)	4 (17%)	4 (17%)	5 (21%)
Concept Men	3 (12%)	9 (36%)	9 (36%)	2 (8%)	2 (8%)
MRE XVII Women	7 (28%)	9 (36%)	4 (14%)	4 (14%)	1 (4%)
MRE XVII Men	22 (27%)	26 (32%)	5 (6%)	12 (17%)	7 (9%)

[1] Values are number of subjects with percentage of ration and gender group in parentheses. Measured body weight data and, therefore, kcal/kg figures were available on 24 women in the Concept group, 25 men in the Concept group, 25 women in the MRE XVII group, and 72 men in the MRE XVII ration group.

[2] Energy intake figures for various levels of physical activity were extrapolated from factors provided in the 1989 RDA publication (NRC, 1989).

ENERGY EXPENDITURE

Similar to energy intakes, there were wide ranges in energy expenditures during the FTX. Energy expenditures measured by doubly-labeled water in the subgroup of 17 women ranged from 2025 to 3205 kcal, while values of the 9 men measured ranged from 2897 to 4942 kcal. Mean energy expenditures of the female and male volunteers were 2745 ± 87 kcal/d (mean ± S.E.) and 3956 ± 243 kcal/d, respectively, suggesting a significant energy deficit. Two-way ANOVA indicated these unadjusted means were significantly different ($p \leq .0001$), and there was no interaction between ration group and gender.

When energy expenditure is expressed on the basis of body weight (i.e., kilocalories per kilogram per day [kcal/kg/day]), there was no difference in mean energy expenditures between the women (44.9 ± 1.5) and men (45.5 ± 2.3) measured. There also was no difference in the mean energy expenditures of subjects in the two ration groups, whether on an absolute or per kilogram body weight basis. Table 5 presents absolute and weight adjusted energy expenditure values. Energy expenditures at the levels measured in this study indicate that the overall physical activity of combat support hospital personnel during an FTX is heavy (See Table 6).

Table 5. Energy Expenditure Values for Men and Women by Ration.
(mean ± standard error)

	Women		Men		Combined
	Kcal/day	Kcal/kg/day	Kcal/day	Kcal/kg/day	Kcal/kg/day
Concept Ration	2929 ± 66	46.0 ± 2.2	3891 ± 394	43.6 ± 1.7	45.0 ± 1.5^{z}
MRE XVII	2582 ± 133	44.0 ± 2.1	4037 ± 306	47.9 ± 4.9	45.2 ± 2.0^{z}
Combined	2745 ± 87^{a}	44.9 ± 1.5	3956 ± 243^{b}	45.5 ± 2.3	45.1 ± 1.2

Values with different superscripts were statistically different at $p \leq .05$.

Table 6. Proportion[1] of Subjects with Energy Expenditures of Varying Activity Levels

	Energy/kg body weight				
Women	**<24**	**24-32.5**	**32.6-36**	**36.1-40.5**	**>40.5**
Men	**<25**	**25-34.5**	**34.6-39.5**	**39.6-45.5**	**>45.5**
Level of Activity	Resting	Sedentary	Light	Moderate	Heavy
Women	0	0	1 (6%)	3 (18%)	13 (76%)
Men	0	1 (11%)	1 (11%)	2 (22%)	5 (55%)

[1] Values are number of subjects with percentage of ration and gender group in parentheses.

Table 7 shows the breakdown of energy expenditures by job category. Administrative personnel were members of the command staff. Medical personnel included practical nurses, medics, and one laboratory technician. Supply and logistics jobs were categorized as support. The only major difference in energy expenditures was between administrative and other jobs. Medical and support personnel expended similar amounts of energy if energy expenditure is based on body weight.

Table 7. Energy Expenditures by Job Category.
(mean ± standard deviation)

		n	Energy Expenditure kcal/day	kcal/**kg**/day
Women				
	Administrative	4	2332 ± 373	38.7 ± 5.1
	Support	3	2781 ± 320	44.1 ± 3.8
	Medical	10	2899 ± 233	47.7 ± 5.5
Men				
	Administrative	1	3709	34.3
	Support	2	4174 ± 431	49.2 ± 9.7
	Medical	6	3925 ± 886	46.1 ± 5.3

MACRONUTRIENT INTAKE

There was no MRDA for carbohydrate at the time of the study, nor is there a current Military Dietary Reference Intake (MDRI) (10-11); however, the Committee on Military Nutrition Research (CMNR) of the National Academy of Sciences has recommended that operational rations provide at least 400 g carbohydrate, to allow for replenishment of muscle and liver glycogen stores (7). Carbohydrate intakes at this level were only achieved by the group of men eating the Concept ration (418 ± 90 g).

Although men consumed more carbohydrate than women in the same ration group, when intake is expressed on the basis of body weight, there is no difference in mean carbohydrate intake between women and men within the same ration group (see Table 3). Mean carbohydrate intakes in the Concept group were 5.2 ± 1.84 g/kg for women and 5.2 ± 1.41 g/kg for men. Weight adjusted carbohydrate intakes in the MRE XVII group were on average 4.3 ±1.46 g/kg for women and 4.2 ± 1.52 g/kg for men.

Tables 8 and 9 show that, for both women and men, mean carbohydrate were greater in the Concept ration group than in the MRE XVII group (although the difference was not statistically significant on a per kilogram basis for women in the Concept group). Neither ration group achieved a mean carbohydrate intake of 6 g/kg body weight, which is the recommendation for individuals exercising 1 hour a day (6).

Mean protein intakes of women and men in both ration groups were below the MDRIs for protein. However, when protein intakes are expressed as intake per kilogram body weight, mean intakes of women and men in both ration groups met the RDA of 0.8 g/kg BW. As for carbohydrate, mean protein intakes per kilogram body

weight did not differ between women and men in the same ration group but did differ between ration groups (see Tables 8 and 9 for values and levels of significance). Opposite of carbohydrate intakes, weight adjusted protein intakes were lower in the Concept ration group than in the MRE XVII group. The level of protein intake of women and men in the Concept group averaged 0.86 g/kg and 0.85 g/kg, respectively. Women in the MRE XVII group consumed 0.94 ± .32 g protein per kilogram body weight, while men in that group consumed 1.06 ± .34 g protein/kg.

Analyses of the proportions of energy from carbohydrate, protein, and fat found no differences between men and women and no interaction between gender and ration group. However, there is a significant ($p<.0001$) difference in the macronutrient distributions of the ration groups. Figure 2 shows the proportions of total calories consumed from carbohydrate, protein, and fat. With the exception of women in the MRE XVII group, the macronutrient distributions of mean intakes parallel those of the respective ration provision (see Figure 3).

Figure 2. Macronutrient distributions of energy intake

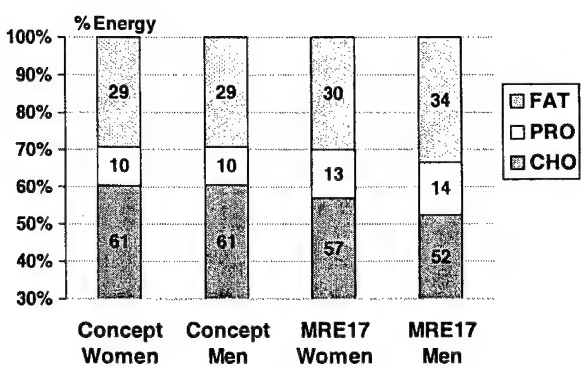
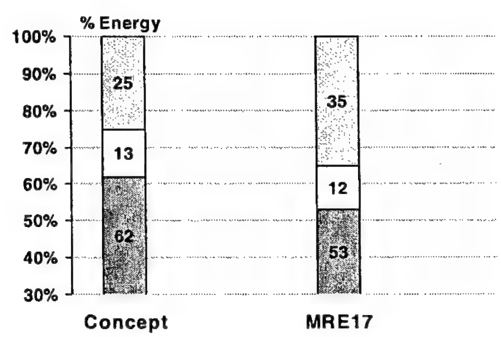


Figure 3. Macronutrient distributions of test rations as provided



VITAMIN AND MINERAL[a] INTAKES

As expected, women consumed lesser amounts of all analyzed vitamins and minerals than did men, regardless of ration assignment (see Table 3). Mean nutrient intakes of women and men in the Concept ration group differed significantly for niacin, folate, vitamin B_{12}, vitamin C, calcium, and sodium. However, when nutrient intakes are adjusted for total energy intake by ANCOVA, there were no differences in nutrient intakes between women and men in the Concept ration group that cannot be explained by differences in energy intake. Mean nutrient intakes of women and men in the MRE

[a]The iron and calcium intake values presented in this section are based on average MRE cracker data with mostly fortified products. The crackers provided in this test were not fortified. See the later section, *MRE Cracker Analysis*, for a full explanation and reanalysis of iron and calcium intakes.

.XVII group differed significantly for vitamin A, thiamin, riboflavin, niacin, folate, vitamin B_6, vitamin B_{12}, calcium, iron, magnesium, potassium, sodium, and zinc. Only intakes of vitamin B_{12} and zinc were significantly different between women and men in the MRE XVII group after adjusting for energy intake.

Table 8 outlines the nutrient intakes of women in the two ration groups. Absolute nutrient intakes of women in the two ration groups differed for riboflavin, folate, vitamin B_{12}, vitamin E, iron, and zinc. Women in the Concept group consumed greater amounts of riboflavin, folate, and iron; while women in the MRE XVII group consumed more vitamin B_{12}, vitamin E, sodium per 1000 kcal, and zinc. ANCOVA indicated the mean intakes of these nutrients, except for iron, were still significantly different between women in the two ration groups after adjusting for energy intake. In addition, energy-adjusted mean intakes of vitamin A, vitamin B_6, and potassium were greater in women in the Concept group than in the MRE XVII group.

Table 8. Energy and Nutrient Intakes per Day of WOMEN by Ration Group.*
(Mean ± standard deviation)

Nutrient (unit)	**Criteria**[1]	**Concept** *(n=26)*[2]	**MRE XVII** *(n=28)*[2]	ANOVA[3] *p*	ANCOVA[3] *p*
MULTIVARIATE EFFECT OF GROUP				*≤.0001*	*≤.001*
Energy (Kcal)	2000–2800	2093 ± 570	1834 ± 500	ns	
Kcal/kg body weight	see text	33.0 ± 10.6	28.8 ± 8.2	ns	ns
Carbohydrate (g)	na	325 ± 102	272 ± 90	.048	ns
Carbohydrate (g/kg BW)	na	5.2 ± 1.9	4.3 ± 1.4	ns	.005
Protein (g)	*80*	54 ± 14	59 ± 17	ns	.002
Protein (g/kg BW)	[0.8+][4]	0.87 ± 0.27	0.95 ± 0.32	ns	.045
Fat (g)	na	68 ± 21	60 ± 18	ns	ns
Monounsaturated fat (g)		not analyzed	24.7 ± 8.9	—	—
Polyunsaturated fat (g)		not analyzed	8.6 ± 3.8	—	—
Saturated fat (g)		not analyzed	18.8 ± 6.1	—	—
Cholesterol (mg)	[≤300]	105 ± 66	122 ± 44	ns	ns
Dietary Fiber (g)	[20–35]	11.2 ± 4.2	13.5 ± 4.7	ns	≤.0001
VITAMINS					
Vitamin A (μg RE)[5]	800	789 ± 520	1000 ± 555	ns	.019
Carotene (μg RE)[5]	na	*not analyzed*	250 ± 169	—	—
Thiamin (mg)	1.2	2.5 ± 1.0	2.2 ± 1.1	ns	ns
Riboflavin (mg)	1.4	1.8 ± 0.6	1.4 ± 0.5	.006	.033
Niacin (mg)	16	22.0 ± 5.4	20.2 ± 6.2	ns	ns
Folate (μg)	400	243 ± 89	147 ± 54	≤.0001	≤.0001
Vitamin B_6 (mg)	2.0	1.8 ± 0.7	2.3 ± 1.1	ns	.003

Table 8. Energy and Nutrient Intakes per Day of WOMEN by Ration Group.*
(Mean ± standard deviation) Continued

Nutrient (unit)	**Criteria**[1]	**Concept** *(n=26)*[2]	**MRE XVII** *(n=28)*[2]	ANOVA[3] *p*	ANCOVA[3] *p*
Vitamin B_{12} (μg)	3.0	1.7 ± 1.1	2.3 ± 1.0	ns	.031
Vitamin C (mg)	60	224 ± 141	212 ± 113	ns	ns
Vitamin E (mg TE)[6]	10	5.7 ± 2.0	13.1 ± 6.9	≤.0001	≤.0001
MINERALS					
Calcium (mg)	800[7]	540 ± 284	458 ± 163	ns	ns
Copper (mg)	2–3	*not analyzed*	1.33 ± .36	—	—
Iron (mg)	18[8]	14.2 ± 4.6	11.9 ± 3.4	.035	ns
Magnesium (mg)	350	217 ± 68	206 ± 61	ns	ns
Potassium (mg)	1875–5625	1681 ± 576	1789 ± 521	ns	.018
Sodium (mg)	~4100	3326 ± 1040	3283 ± 799	ns	ns
Sodium (mg/1000 kcal)	1400–1700	1589 ± 369	1790 ± 268	.013	.033
Zinc (mg)	15	6.4 ± 1.9	8.1 ± 2.6	.007	≤.0001

*See footnotes after Table 9.

Table 9. Energy and Nutrient Intakes per Day of MEN by Ration Group.*
(Mean ± standard deviation)

Nutrient (unit)	**Criteria**[1]	**Concept** *(n=26)*[2]	**MRE XVII** *(n=82)*[2]	ANOVA[3] *p*	ANCOVA[3] *p*
MULTIVARIATE EFFECT OF GROUP				≤.0001	≤.0001
Energy (Kcal)	2800–3600	2688 ± 517	2427 ± 690	.050	—
Kcal/kg body weight	*na*	33.6 ± 8.1	30.6 ± 10.2	ns	ns
Carbohydrate (g)	*na*	418 ± 90	330 ± 105	≤.0001	≤.0001
Carbohydrate (g/kg BW)	see text	5.2 ± 1.4	4.1 ± 1.5	.003	.009
Protein (g)	100	68 ± 14	83 ± 22	.002	≤.0001
Protein (g/kg BW)	[0.8+][4]	0.87 ± 0.19	1.07 ± 0.34	.004	≤.0001
Fat (g)	*na*	86 ± 17	90 ± 30	ns	≤.0001
Monounsaturated fat (g)	*na*	*not analyzed*	38.7 ± 13.7	—	—
Polyunsaturated fat (g)	*na*	*not analyzed*	12.9 ± 5.7	—	—
Saturated fat (g)	*na*	*not analyzed*	29.0 ± 9.4	—	—
Cholesterol (mg)	[≤300]	188 ± 119	191 ± 54	ns	ns
Dietary Fiber (g)	[25–35]	13.4 ± 3.6	16.1 ± 5.7	.031	≤.0001

Table 9. Energy and Nutrient Intakes per Day of MEN by Ration Group.*
(Mean ± standard deviation) Continued

Nutrient (unit)	Criteria [1]	Concept *(n=26)* [2]	MRE XVII *(n=82)* [2]	ANOVA [3] *p*	ANCOVA [3] *p*
VITAMINS					
Vitamin A (μg RE) [5]	1000	766 ± 318	1295 ± 709	≤.0001	≤.0001
Carotene (μg RE) [5]	*na*	*not analyzed*	253 ± 139	—	—
Thiamin(mg)	1.6	2.8 ± 0.9	3.0 ± 1.5	ns	.001
Riboflavin (mg)	1.9	2.0 ± 0.5	1.9 ± 0.6	ns	ns
Niacin (mg)	21	25.8 ± 5.7	27.6 ± 8.0	ns	.000
Folate (μg)	400	310 ± 88	180 ± 56	≤.0001	≤.0001
Vitamin B_6 (mg)	2.2	1.9 ± 0.6	3.2 ± 1.6	≤.0001	≤.0001
Vitamin B_{12} (μg)	3.0	1.9 ± 0.7	3.2 ± 0.9	≤.0001	≤.0001
Vitamin C (mg)	60	344 ± 138	224 ± 120	≤.0001	≤.0001
Vitamin E (mg TE) [6]	10	6.3 ± 2.0	14.2 ± 6.2	≤.0001	≤.0001
MINERALS					
Calcium (mg)	800 [7]	695 ± 232	606 ± 221	ns	ns
Copper (mg)	2–3	not analyzed	1.77 ± .54	—	—
Iron (mg)	10	15.9 ± 3.2	15.6 ± 4.5	ns	.003
Magnesium (mg)	350	275 ± 74	280 ± 98	ns	.003
Potassium (mg)	1875–5625	2007 ± 684	2213 ± 668	ns	≤.0001
Sodium (mg)	~5500	4327 ± 929	4425 ± 1171	ns	.003
Sodium (mg/1000 kcal)	1400–1700	1610 ± 279	1823 ± 293	.001	.004
Zinc (mg)	15	7.1 ± 1.5	11.8 ± 3.1	≤.0001	≤.0001

Footnotes for Tables 8 and 9:

[1]Most values are Military Recommended Dietary Allowances as presented in AR 40-25, May 1985. The MRDAs were the intake goals in effect at the time of the study, as well as when the rations were formulated. Values in brackets are recommendations of national health organizations.

[2]Nutrients per kg calculated for subjects with body weight data. Body weight data available on 24 women in the Concept ration group, 25 women in the MRE XVII group, 25 men in the Concept group, and 72 men in the MRE XVII ration group.

[3] Significance of the effect of ration group within gender groups determined by one-way MANOVA and MANCOVA (with energy as the covariate) by group subsequent to two-way MANOVA and MANCOVA which found significant group, gender, and group by gender interaction effects ($p \leq .0001$).

[4] Protein needs are greater in physically active individuals.

[5] Unit of measure is microgram Retinol Equivalent, μg RE.

[6] Unit of measure is milligram alpha Tocopherol Equivalent, mg TE.

[7] The current Dietary Reference Intake from the National Academy of Sciences for calcium for the 19–50 year age groups is an Adequate Intake (AI) of 1000 mg.

[8] The current Dietary Reference Intake from the National Academy of Sciences for iron for women is a Recommended Dietary Allowance (RDA) of 18 mg.

Table 9 compares the nutrient intakes of men in the two ration groups. Men in the Concept ration group had higher absolute intakes of folate and vitamin C than men in the MRE XVII group, while men in the MRE XVII group consumed more of vitamins A, B_6, B_{12}, and E, and the mineral zinc, as well as sodium per 1000 kcal. These nutrient intakes still were significantly different after adjusting for energy intake with ANCOVA, as were those for thiamin, niacin, iron, magnesium, and potassium. The energy adjusted mean intake of iron was higher in men in the Concept ration group, but adjusted means for niacin, magnesium, and potassium were higher in the MRE XVII group than the Concept group.

Comparing mean nutrient intakes to recommended dietary allowances, as typically done in ration tests, is one way to assess the ability of a ration to meet the nutrient needs of a group. Since dietary allowances are intended to cover the needs of practically all members of a group, if the mean intake of a group meets the dietary allowance for a nutrient, few individuals in the group are likely at risk of deficient intake of that nutrient. Tables 8 and 9 show mean nutrient intakes of women and men, respectively, broken down by ration group, along with the gender specific dietary allowances or goals. Most nutrient intakes are compared to MRDAs rather than the newer MDRIs, because the MRDAs were the allowances in effect at the time of the study.

In both ration groups, neither women nor men achieved mean nutrient intakes at MRDA or MDRI levels for folate, calcium, magnesium, or zinc. Mean nutrient intakes of women and men in the Concept ration group were below the MRDAs for vitamin E. Women in the MRE XVII group and men in both ration groups had mean dietary intakes of vitamin A less than their MRDAs. Women and men subsisting on the MRE XVII had mean sodium intakes per 1000 kcal (1790 ± 268 mg/1000 kcal and 1828 ± 305 mg/1000 kcal, respectively) greater than the accepted goal of 1400–1700 mg/1000 kcal, taken from AR 40-25. The mean daily iron intake by women receiving MRE XVII (11.9 ± 3.5 mg) was moderately lower than the MDRI of 15 mg/day, but was much lower than the 18 mg 2000 RDA for iron (18). Women in the Concept ration group consumed an average of 14.2 mg/day iron, still less than the MDRI or RDA.

The MRDA for calcium at the time of the study was 800 mg. Mean daily calcium intakes of women were only 540 ± 284 mg in the Concept ration group and 458 ± 163 mg in the MRE XVII group. Men in the Concept ration group consumed a mean of 695 ± 232 mg calcium per day, while those in the MRE XVII group consumed 608 ± 222 mg/d. The new MDRI for calcium is 1000 mg. Compared to the MDRI, mean calcium intakes of women and men in this study were about half of this dietary goal.

COMPARISONS TO DIETARY ALLOWANCES[b]

To estimate the prevalence of low dietary intakes, individuals' nutrient intakes were compared to dietary allowances. If an individual consumes, on average, the dietary allowance for a nutrient, nutrient needs probably are being met. The further nutrient intake is below the allowance, the more likely the intake is inadequate. Table 10 categorizes the subjects according to nutrient intake ranges in comparison to the 1989 RDAs (27) or the subsequent Dietary Reference Intakes (15–18) and the 2001 MDRIs (11).

Table10. Number and Proportion of Subjects with Nutrient Intakes at Select Levels Compared to Reference Values[1].

	DRIs or 1989 RDAs		MDRIs		
	< EAR or <70% RDA	***≥ RDA or AI***	***< 70%***	***70%–99%***	***≥100%***
Protein					
Concept Men	2 (8%)	15 (58%)	6 (23%)	20 (77%)	0
Concept Women	2 (8%)	18 (69%)	8 (31%)	16 (61%)	2 (8%)
MRE XVII Men	5 (6%)	63 (77%)	18 (22%)	39 (48%)	25 (30%)
MRE XVII Women	3 (11%)	17 (61%)	11 (39%)	10 (36%)	7 (25%)
Fat (% kcal)			***<30% fat***	***30%–35% fat***	***>35% fat***
Concept Men	—	—	21 (81%)	3 (12%)	2 (8%)
Concept Women	—	—	13 (50%)	11 (42%)	2 (8%)
MRE XVII Men	—	—	23 (28%)	29 (35%)	30 (37%)
MRE XVII Women	—	—	13 (46%)	13 (46%)	2 (7%)
VITAMINS					
Vitamin A[2]					
Concept Men	9 (35%)	7 (27%)	9 (35%)	10 (38%)	7 (27%)
Concept Women	8 (31%)	10 (38%)	8 (31%)	8 (31%)	10 (38%)
MRE XVII Men	20 (24%)	48 (59%)	20(24%)	14 (17%)	48 (59%)
MRE XVII Women	5 (18%)	12 (43%)	5 (18%)	11 (39%)	12 (43%)
Thiamin					
Concept Men	0	25 (96%)	0	1 (4%)	25 (96%)
Concept Women	1 (4%)	24 (92%)	1 (4%)	4 (15%)	22 (85%)
MRE XVII Men	5 (6%)	76 (93%)	6 (7%)	9 (11%)	67 (82%)
MRE XVII Women	4 (14%)	24 (86%)	3 (11%)	2 (7%)	23 (82%)

[b]The iron and calcium intakes compared to allowances in this section were calculated with average MRE cracker data based on mostly fortified products. The crackers provided in this test were not fortified. See the later section, *MRE Cracker Analysis*, for a full explanation and reanalysis of iron and calcium intakes.

Table10. Number and Proportion of Subjects with Nutrient Intakes at Select Levels Compared to Reference Values[1]. (Continued)

	DRIs or 1989 RDAs		MDRIs		
	< EAR or <70% RDA	***≥ RDA or AI***	***< 70%***	***70%–99%***	***≥100%***
Riboflavin					
Concept Men	1 (4%)	25 (96%)	1 (4%)	8 (31%)	17 (65%)
Concept Women	2 (8%)	23 (88%)	2 (8%)	3 (12%)	21 (81%)
MRE XVII Men	9 (11%)	66 (80%)	16 (20%)	33 (40%)	33 (40%)
MRE XVII Women	3 (11%)	20 (71%)	6 (21%)	10 (36%)	12 (43%)
Niacin					
Concept Men	0	24 (92%)	2 (8%)	3 (12%)	21 (81%)
Concept Women	1 (4%)	24 (92%)	1 (4%)	3 (12%)	22 (85%)
MRE XVII Men	1 (1%)	76 (93%)	4 (5%)	13 (16%)	65 (79%)
MRE XVII Women	1 (4%)	24 (86%)	1 (4%)	6 (21%)	21 (75%)
Folate					
Concept Men	13 (50%)	4 (15%)	9 (35%)	13 (50%)	4 (15%)
Concept Women	24 (92%)	2 (8%)	19 (73%)	5 (19%)	2 (8%)
MRE XVII Men	81 (99%)	0	79 (96%)	3 (4%)	0
MRE XVII Women	28 (100%)	0	27 (96%)	1 (4%)	0
Vitamin B_6					
Concept Men	2 (8%)	20 (77%)	9 (35%)	9 (35%)	8 (31%)
Concept Women	3 (12%)	21 (81%)	7 (27%)	11 (42%)	8 (31%)
MRE XVII Men	4 (5%)	75 (92%)	10 (12%)	18 (22%)	54 (66%)
MRE XVII Women	4 (15%)	23 (82%)	7 (25%)	7 (25%)	14 (50%)
Vitamin B_{12}					
Concept Men	15 (58%)	7 (27%)	15 (58%)	10 (38%)	1 (4%)
Concept Women	18 (69%)	5 (19%)	19 (73%)	4 (15%)	3 (12%)
MRE XVII Men	9 (11%)	64 (78%)	10 (12%)	23 (28%)	49 (60%)
MRE XVII Women	12 (43%)	14 (50%)	12 (43%)	9 (32%)	7 (25%)
Vitamin C[3]					
Concept Men	1 (4%)	23 (88%)	1 (4%)	0	25 (96%)
Concept Women	4 (15%)	20 (77%)	2 (8%)	2 (8%)	22 (85%)
MRE XVII Men	8 (10%)	60 (73%)	2 (2%)	4 (15%)	76 (93%)
MRE XVII Women	1 (4%)	21 (75%)	0	1 (4%)	

See footnotes on page 25, at the end of the table.

Table10. Number and Proportion of Subjects with Nutrient Intakes at Select Levels Compared to Reference Values[1]. (Continued)

	DRIs or 1989 RDAs		MDRIs		
	< EAR or <70% RDA	*≥ RDA or AI*	*< 70%*	*70%–99%*	*≥100%*
Vitamin E[4]					
Concept Men	26 (100%)	0	17 (65%)	8 (31%)	1 (4%)
Concept Women	26 (100%)	0	13 (50%)	11 (42%)	2 (8%)
MRE XVII Men	47 (57%)	23 (28%)	11 (13%)	16 (21%)	55 (66%)
MRE XVII Women	18 (64%)	4 (14%)	2 (7%)	5 (18%)	21 (754%)
MINERALS					
Calcium					
Concept Men	13 (50%)	3(12%)	8 (31%)	8 (31%)	10 (38%)
Concept Women	20 (77%)	3 (12%)	18 (69%)	5 (19%)	3 (12%)
MRE XVII Men	57 (69%)	2 (2%)	36 (44%)	37 (38%)	15 (18%)
MRE XVII Women	26 (93%)	0	22 (79%)	5 (18%)	1 (4%)
Iron					
Concept Men	0	24 (92%)	0	2 (8%)	24 (92%)
Concept Women	3 (12%)	3 (12%)	7 (27%)	7 (27%)	12 (46%)
MRE XVII Men	1 (1%)	79 (96%)	2 (2%)	8 (10%)	72 (88%)
MRE XVII Women	3 (11%)	2 (79%)	12 (43%)	11 (39%)	5 (18%)
Magnesium					
Concept Men	14 (54%)	1 (4%)	10 (38%)	12 (46%)	4 (15%)
Concept Women	20 (77%)	3 (12%)	11 (42%)	12 (46%)	3 (12%)
MRE XVII Men	48 (58%)	14 (17%)	35 (43%)	29 (36%)	18 (22%)
MRE XVII Women	21 (75%)	4 (14%)	17 (61%)	8 (29%)	2 (8%)
Phosphorus					
Concept Men	2 (8%)	20 (77%)	2 (8%)	13 (50%)	11 (42%)
Concept Women	7 (27%)	13 (50%)	7 (27%)	9 (35%)	10 (38%)
MRE XVII Men	1 (1%)	77 (94%)	1 (1%)	6 (7%)	75 (91%)
MRE XVII Women	2 (7%)	24 (86%)	2 (7%)	10 (36%)	16 (57%)
Zinc					
Concept Men	26 (100%)	0	26 (100%)	0	0
Concept Women	24 (92%)	0	26 (100%)	0	0
MRE XVII Men	17 (21%)	26 (32%)	17 (21%)	39 (48%)	26 (32%)
MRE XVII Women	13 (46%)	2 (7%)	19 (68%)	9 (32%)	0

See footnotes on page 25, at the end of the table.

Table10. Number and Proportion of Subjects with Nutrient Intakes at Select Levels Compared to Reference Values[1]. (Continued)

	DRIs or 1989 RDAs		MDRIs		
	< EAR or <70% RDA	*≥ RDA or AI*	*< 70%*	*70%–99%*	*≥100%*
Potassium					
Concept Men	—	—	19 (73%)	5 (19%)	2 (8%)
Concept Women	—	—	16 (62%)	6 (23%)	4 (15%)
MRE XVII Men	—	—	46 (56%)	29 (36%)	7 (8%)
MRE XVII Women	—	—	12 (43%)	13 (46%)	3 (11%)
Sodium, mg/1000 kcal			***<1400 mg***		***> 1700 mg***
Concept Men	—	—	5 (19%)		10 (38%)
Concept Women	—	—	10 (38%)		9 (35%)
MRE XVII Men	—	—	3 (5%)		56 (68%)
MRE XVII Women	—	—	1 (4%)		17 (61%)

[1] DRI, Dietary Reference Intake. DRI comprise Recommended Dietary Allowances (RDA), Estimated Average Requirement (EAR), and Adequate Intake (AI) for nutrients for which there is insufficient information upon which to establish an EAR. For nutrients without an EAR, the proportion of subjects with a high likelihood of inadequate intake was estimated to be the number of subjects with nutrient intakes <70% of the AI or 1989 RDA.

[2] Vitamin A intakes compared to 1989 RDAs because the food composition data in Retinol Equivalents (RE) could not be converted to Retinol Activity Equivalents (RAE).

[3] EAR and RDA for vitamin C based on individual smoking status.

[4] The DRIs for vitamin E are for only the α-tocopherol form. Dietary intakes in α-tocopherol equivalents were multiplied by 0.8 to estimate α-tocopherol for comparison to the DRIs, as suggested in the IOM report (IOM, 2000).

The large discrepancy between frequency distributions of persons with protein intakes meeting or exceeding the MDRI and RDA is because the MDRIs for protein (72 g for women and 91 g for men) are much greater than the RDA (individually calculated at 0.8g/kg body weight and averaging 50 g for the women and 64 g for men). Relatively few individuals consumed the MDRI for protein and a large proportion of subjects in both ration groups consumed less protein than 70% of the MDRI. Surprisingly, there were some individuals—five women and seven men—with diets providing less than the estimated average requirement (EAR) for protein.

There is no MDRI for fat, but AR 40-25 recommends that fat intake not exceed 35% of calories in operational settings. Compared to this guideline, 30 of the 82 men in the MRE XVII group (37% of the group) exceeded it—5 with fat intakes greater than 40% of calories. Only 2 men and 2 women in the Concept group and 2 women in the MRE XVII group had diets containing more than 35% fat by calories. One woman in the Concept group reported a diet with 50% of calories from fat. Dietary guidelines from

most national health organizations recommend that fat intake not exceed 30% of calories (35). Fifty percent of the women in the Concept group and 57 percent of the women in the MRE XVII group exceeded this stricter recommendation. Only 5 men (19%) in the Concept group had diets comprised of more than 30% of calories as fat, but 60 men (73%) in the MRE XVII group derived more than 30% of their energy from fat.

Referring to Table 10, there were large proportions of subjects in both ration groups with diets likely inadequate in vitamin A, folate, vitamin B_6, vitamin B_{12}, vitamin E, calcium, magnesium, and zinc. All of the women and all but one of the men subsisting on MRE XVII and 24 of 26 women eating the Concept ration had diets containing less than the EAR for folate. It should be noted that the 2000 RDA (15 mg) and EAR (12 mg) for vitamin E as α-tocopherol are both higher than the MDRIs (8 mg for women and10 mg for men) expressed as α-tocopherol equivalents (11, 20). This explains the much larger number of subjects deemed at risk of inadequate intake when vitamin E intakes are compared to the EAR than when compared to a value <70% MDRI. The prevalences of potentially low intakes of vitamin E and zinc were greater in subjects consuming the Concept ration than MRE XVII, while prevalences of low calcium intakes were greater in women and men in the MRE XVII group than in the Concept group.

Greater proportions (p<0.01) of women than men in both ration groups had intakes of calcium and magnesium that were potentially lower than needs. Not unexpectedly, there were very few men likely at risk of inadequate iron intake. However, the prevalence of low iron intakes in women also was low. Only 3 women in the Concept group (12%) and 3 in the MRE XVII group (11%) consumed less than the EAR (6 mg/d) for iron.

Mean potassium intakes of most women and men in both ration groups were less than the MDRIs (2500 mg and 3200 mg for women and men, respectively). The 1989 RDA publication (27) presented an adult estimated daily minimum requirement for potassium of approximately 1,600 mg to 2,000 mg. Sixty-eight percent of women and 46% of men had average diets containing less than this estimated minimum requirement.

Sodium intakes per 1000 kcal were compared to the acceptable range of 1400 to 1700 mg/1000 kcal for garrison feeding prescribed by AR 40-25. Thirty six percent of subjects consuming the Concept ration and 58% of subjects consuming MRE XVII exceeded the guideline.

NUTRIENT DENSITIES OF INTAKES

Because analyses of covariance indicated that many differences in nutrient intakes between women and men or between ration groups were not entirely due to

differences in energy intakes, nutrient densities of the diets were calculated. Nutrient density relates nutrient intake to energy intake and is usually expressed as the quantity of nutrient consumed per 1000 kcal. Average nutrient densities of the diets of women and men within each ration group are outlined in Table 11.

Table 11. Nutrient Densities of Dietary Intakes (Intake per 1000 Kcal) of Women and Men by Ration Group. *(Mean ± Standard Deviation)*

	Concept		**MRE XVII**		Comparisons	
	Women (n=26)	Men (n=26)	Women (n=28)	Men (n=82)	**Ration** ($p\leq$)	**Gender** ($p\leq$)
Dietary Fiber (g/1000 kcal)	5.42 ± 1.72	4.97 ± 0.98	7.44 ± 1.84	6.60 ± 1.32	.0001	.013
Cholesterol (mg/1000kcal)	53 ± 44	69 ± 42	69 ± 25	81 ± 20	.011	.008
VITAMINS						
Vitamin A (μg RE/1000 kcal)[1]	376 ± 221	288 ± 132	540 ± 262	515 ± 209	.0001	ns
Thiamin (mg/1000 kcal)	1.19 ± .39	1.04 ± .26	1.18 ± .50	1.21 ± .39	ns	ns
Riboflavin (mg/1000 kcal)	.90 ± .26	.77 ± .11	.77 ± .20	.76 ± .13	.025	.015
Niacin (mg/1000 kcal)	10.7 ± 2.1	9.7 ± 2.1	11.2 ± 2.3	11.5 ± 1.9	.002	ns
Folate (μg/1000 kcal)	118 ± 36	115 ± 27	80 ± 16	74 ± 13	.0001	ns
Vitamin B_6 (mg/1000 kcal)	.88 ± .31	.70 ± .22	1.23 ± .53	1.28 ± .42	.0001	ns
Vitamin B_{12} (μg/1000 kcal)	.87 ± .58	.71 ± .22	1.26 ± .58	1.37 ± .39	.0001	ns
Vitamin C (mg/1000 kcal)	101 ± 51	125 ± 50	116 ± 55	90 ± 36	ns	ns
Vitamin E (mg αTE/1000 kcal)[2]	2.8 ± .8	2.4 ± .7	7.2 ± 3.6	5.8 ± 1.8	.0001	.012
MINERALS						
Calcium (mg/1000 kcal)	262 ± 148	256 ± 65	251 ± 69	248 ± 57	ns	ns
Iron (mg/1000 kcal)	6.9 ± 1.7	5.9 ± .62	6.5 ± .93	6.4 ± .80	ns	.006
Magnesium (mg/1000 kcal)	105 ± 28	101 ± 16	113 ± 19	115 ± 23	.005	ns
Potassium (mg/1000 kcal)	809 ± 241	739 ± 184	991 ± 220	928 ± 202	.0001	ns
Sodium (mg/1000 kcal)	1591 ± 370	1624 ± 275	1821 ± 287	1857 ± 311	.0001	ns
Zinc (mg/1000 kcal)	3.13 ± .95	2.66 ± .37	4.5 ± 1.2	4.9 ± .73	.0001	ns

[1]Unit of measure for vitamin A is microgram Retinol Equivalent.
[2]Unit of measure for vitamin E is milligram alpha-Tocopherol Equivalent.

A two-way MANOVA found significant differences overall between the mean nutrient densities of women and men and between the two ration groups and an interaction between gender and ration group. The nutrient densities of the diets of women were higher than those of men for dietary fiber, riboflavin, vitamin E, and iron, while men had denser diets for cholesterol (see Table 11 for levels of significance).

Inspection of Table 10 reveals that the gender differences for riboflavin and iron were mainly due to differences between women and men in the Concept group.

The nutrient densities of diets of subjects in the two ration groups differed for many nutrients. Overall, the diets of individuals consuming the Concept ration were less nutrient dense (i.e., of poorer quality) than those of subjects eating the MRE XVII ration. While the nutrient densities of riboflavin and folate were greater in the diets of subjects in the Concept ration group, the MRE XVII group had denser diets for dietary fiber, vitamin A, niacin, vitamin B_6, vitamin B_{12}, vitamin E, magnesium, and zinc. The MRE XVII group also consumed more dietary fiber, cholesterol, potassium, and sodium on a per 1000 kilocalorie basis.

FOOD SOURCES OF ENERGY & NUTRIENTS

Energy

The top 25 energy contributors in the average diets of women and men in the Concept group are listed in Table 12; Table 13 lists the top 25 energy contributors in the MRE XVII group. Some items on the lists, such as candy and fruit, represent combinations of similar foods. Placement on a list is prescribed by how many subjects consumed the item, as well as how many times each subject consumed the item. A few items made the list because they are high enough in calories that even infrequent consumption by a few subjects provided a significant number of calories to the group intake. For example, because nuts are so high in calories, they ranked number 20 in the list of top energy contributors, providing 33.7 kcal/day to the mean intake of women in the Concept group, despite being consumed by only four women. For these four women, nuts provided an average of 218.8 kcal/d.

Tables 14 and 15 (for the Concept ration group and MRE XVII group, respectively) rank the energy contributions of foods to the diets of only subjects who consumed each item. Continuing the nut illustration, by providing an average of 218.8 kcal to the diets of the four women in the Concept group who consumed them, nuts topped the list of calorie contributors for individual consumers. As another example, 25 men in the Concept group consumed one or more fruits from the ration during the study. The mean energy intake from fruit by these men was 214.4 kcal/day (see Table 14). Averaged over all 26 men in the Concept group, fruit contributed 206.2 kcal of the mean energy intake of the group and was the top energy contributor to the group (Table 12).

Table 12. Top Contributors of ENERGY to Group Mean Daily Intake, Concept Group.

	Women			Men		
Rank		*kcal*	*%Total*		*kcal*	*%Total*
1	Fruit	135.7	6.5	Fruit	206.2	7.7
2	Cereal in Ration	102.5	4.9	P.B. & Jelly Pocket	191.9	7.1
3	Pouch Bread White	102.2	4.9	Pouch Bread White	149.2	5.6
4	Peanut But. & Jelly	101.0	4.8	Ration Candies	117.0	4.4
5	Toaster Pastry in Ration	93.8	4.5	Toaster Pastry in Ration	100.8	3.8
6	Ration Candies	75.1	3.6	Pound Cakes	98.5	3.7
7	MRE Beverage Bases	53.0	2.5	Ergo-Drink, Orange	90.7	3.4
8	Flatbread	52.4	2.5	Flatbread	87.9	3.3
9	Hooah Bar	51.1	2.4	BBQ Chicken Pocket	87.4	3.3
10	Pepperoni Pocket	49.3	2.4	Hooah Bar	85.6	3.2
11	MRE Crackers	46.0	2.2	MRE Beverage Bases	84.8	3.2
12	Meatloaf w/Onion Gravy	43.2	2.1	Nacho Cheese Pocket	82.8	3.1
13	Pound Cakes	43.1	2.1	Pepperoni Pocket	60.1	2.2
14	Tea, sweetened (bulk)	39.4	1.9	Drink, Koolaid-type (bulk)	57.8	2.2
15	Cheese Tortellini	38.6	1.9	Cereal in Ration	57.7	2.2
16	Nacho Cheese Pocket	38.3	1.8	Lemon Poppy Cake	53.2	2.0
17	Sandwich Crackers	35.5	1.7	Chicken Stew	51.7	1.9
18	Nutter Butter Cookies	34.7	1.7	Cheese Tortellini	49.9	1.9
19	Tuna Salad	34.6	1.7	Eggs and Ham	46.8	1.7
20	Nuts, Non-Ration	33.7	1.6	Meatloaf w/Onion Gravy	46.4	1.7
21	Cheddar Goldfish	32.2	1.5	White Rice	45.3	1.7
22	Ergo-Drink, Orange	31.6	1.5	Nutter Butter Cookies	43.9	1.6
23	Shortbread Cookies	29.6	1.4	Chunky Chicken	43.6	1.6
24	Milk, Non-Ration	28.5	1.4	Shortbread Cookies	43.1	1.6
25	Pork Chow Mein	28.0	1.3	Sandwich Crackers	41.7	1.6

Table 13. Top Contributors of ENERGY to Group Mean Daily Intake, MRE XVII Group.

	Women			Men		
Rank		*kcal*	*%Total*		*kcal*	*%Total*
1	Pouch Bread White	166.9	9.2	Pouch Bread White	225.2	9.4
2	Ration Candies	151.1	8.3	MRE Crackers	211.2	8.8
3	MRE Crackers	131.5	7.2	Ration Candies	187.2	7.7
4	Pound Cakes	91.7	5.1	Pound Cakes	136.9	5.6
5	Fruit	90.5	5.0	Peanut Butter	129.8	5.4
6	Peanut Butter	81.1	4.5	Fruit	90.0	3.7
7	Pasta w/Vegetables	59.6	3.3	MRE Beverage Bases	85.9	3.5
8	Fig Bar	57.6	3.2	Cheese Spreads	85.6	3.5
9	Cheese Tortellini	56.1	3.1	Fig Bar	65.3	2.7
10	Drink, Koolaid-type	54.3	3.0	Drink, Koolaid-type (bulk)	64.6	2.7
11	Cheese Spreads	52.4	2.9	Chocolate Covered	53.7	2.2
12	Beef Stew	52.3	2.9	Beef Franks	53.2	2.2
13	MRE Beverage Bases	51.5	2.8	Fudge Brownie	52.9	2.2
14	MRE Granola Bar	45.7	2.5	Cheese Tortellini	52.1	2.2
15	Chili Macaroni	34.2	1.9	Chili Macaroni	52.1	2.2
16	White Rice	30.2	1.7	MRE Granola Bar	47.5	2.0
17	Tea, sweetened (bulk)	30.2	1.7	Pork w/Rice	46.6	1.9
18	MRE Lemon Tea	28.4	1.6	Beef Stew	41.7	1.7
19	MRE Cocoa	27.3	1.5	White Rice	39.9	1.6
20	Beef w/Mushrooms	25.2	1.4	Pasta w/Vegetables	39.4	1.7
21	Beef Franks	24.7	1.4	Beef w/Mushrooms	37.6	1.5
22	Pretzel Sticks	23.7	1.3	Beef Ravioli	37.4	1.5
23	Tuna w/Noodles	23.3	1.3	Tavern Nuts	36.6	1.5
24	Chicken w/Rice	20.0	1.1	Mexican Rice	35.2	1.5
25	Spaghetti w/Meat Sauce	18.8	1.0	Oatmeal Cookie Bar	31.4	1.3

Table 14. Top Contributors of Energy to Diets of CONSUMERS of Those Items, Concept Group.

	Women			Men		
Rank		kcal/d	#		kcal/d	# subj
1	Nuts (NR)	218.8	4	Fruit in ration	214.4	25
2	Milk	214.7	4	PB & Jelly Pocket	199.6	25
3	Toaster Pastry	162.6	15	Potato Chips (NR)	173.7	1
4	Fruit in ration	141.1	25	Pouch Bread White	149.2	26
5	PB & Jelly Pocket	131.3	20	Ration Candy	126.7	24
6	Snack Cake (NR)	127.8	1	Toaster Pastry	124.8	21
7	Grape Nuts Cereal (NR)	121.6	1	BBQ Chicken Pocket	119.6	19
8	Cereal in ration	121.2	22	Nacho Cheese Pocket	113.3	19
9	Pouch Bread White	115.5	23	Ergo-Drink, Orange	112.3	21
10	Crackers, Animal (NR)	114.7	1	Beverage Base	110.2	20
11	Juice, Grapefruit (NR)	113.1	1	Pound Cakes	106.7	24
12	Pepperoni Pocket	106.9	12	Hooah Bar	106.0	21
13	Nacho Cheese Pocket	99.6	10	Carbonated Drinks (NR)	94.9	10
14	Beverage Base	98.5	14	Eggs and Ham	93.6	13
15	Tea, sweetened (NR)	93.0	11	Flatbread	91.4	25
16	Ration Candy	84.1	23	Chicken Stew	89.7	15
17	Pound Cakes	80.0	14	Pepperoni Pocket	86.8	18
18	Juice, Orange (NR)	77.2	2	Peanut Butter	85.7	11
19	Chicken Leg, fried (NR)	73.0	3	Drink, Koolaid-type	83.5	18
20	Beef Steak (NR)	72.4	1	Cereal in ration	83.4	18
21	MRE Crackers	70.3	17	Lemon Poppy Cake	81.3	17
22	Meatloaf w/Onion Gravy	70.1	16	White Rice	73.5	16
23	Hooah Bar	69.9	19	Ramen Noodles	73.1	12
24	Nutter Butter Cookie	69.4	13	Shortbread Cookies	70.0	16
25	Ergo-Drink, Orange	63.3	13	Cheese Tortellini	64.9	20

NR denotes non-ration item.

Table 15. Top Contributors of Energy to Diets of CONSUMERS of Specific Items, MRE XVII Group.

	Women			Men		
Rank		*kcal/d*	*# subj*		*kcal/d*	*# subj*
1	Pouch Bread White	222.5	21	Pouch Bread White	263.8	70
2	MRE Crackers	160.1	23	MRE Crackers	227.9	76
3	Ration Candy	151.1	28	Hamburger, double (NR)	186.2	1
4	Bagel (NR)	134.4	1	Peanut Butter	174.6	61
5	Pork w/Rice	132.0	3	Ration Candy	173.3	82
6	Beef Stew	121.9	12	Hamburger, Big Mac (NR)	168.7	1
7	Peanut Butter	113.6	20	Sandwich Crackers, MRE	154.2	1
8	Pound Cakes	111.7	23	Pound Cakes	151.8	74
9	Ramen (NR)	108.7	3	Beverage Base	122.1	56
10	Fruit in ration	93.9	27	Milk (NR)	120.2	9
11	Ramen (Concept Ration)	93.3	1	Sausage, summer (NR)	118.1	1
12	Fig Bar	80.7	20	Chicken Noodle Soup	114.5	1
13	Beverage Base	80.1	18	Drink, Koolaid-type	112.7	47
14	Drink, koolaid-type (bulk)	80.0	19	Pork w/Rice	106.1	36
15	Cheese Spreads	77.3	19	Cheese Spreads	103.2	68
16	MRE Cocoa	76.5	10	Carbonated Drinks (NR)	99.6	16
17	Pasta w/Vegetables	75.9	22	Soup, vegetable (NR)	99.4	4
18	MRE Granola Bar	75.2	17	Fruit	97.1	76
19	Chicken leg, fried (NR)	71.7	1	Beef Franks	92.9	47
20	Cheese Tortellini	71.4	22	Tuna Noodle Casserole	91.2	1
21	Beef w/Mushrooms	70.4	10	Crackers, graham (NR)	84.6	1
22	Toaster Pastry	70.0	1	Chocolate Covered	83.2	53
23	Beef Franks	69.1	10	Fig Bar	81.1	66
24	Chili Macaroni	68.4	14	Chicken w/Rice	80.8	28
25	Spaghetti, canned (NR)	65.6	1	Chili Macaroni	76.2	56

* NR denotes non-ration food.

Fruits were the major calorie contributors in the diets of women and men in the Concept ration group. Near the top of the lists and with similar rankings for women and men are pouch bread (shelf-stable bread), the peanut butter and jelly pocket sandwich, the apple toaster pastry, and candy. One of the major differences between women and men in the Concept ration group was the ranking of cereal. Breakfast cereal contributed 4.9% of the total energy in the average diet of women in the Concept group but only 2.2 % of the calories in the diet of all the men in that group. MRE crackers, sweetened tea provided from the kitchen, and Nutrigrain cereal bars also ranked higher in the diets of women than men in the Concept group, while the pound cakes, Ergo drink, the Koolaid-type fruit drink provided by the kitchen, and many of the pocket sandwiches were greater calorie contributors to the diets of the men in the group.

Largely because of widespread availability in the MRE XVII ration, bread, crackers, the MRE candies, pound cakes, fruit, and peanut butter were major providers of energy for both women and men in that group and shared similar rankings on the lists of top energy providers. Women in the MRE XVII group derived slightly greater proportions of their average energy intake than men from the vegetarian entrees. Most of the non-vegetarian entrees, the cheese spreads, and Tavern nuts ranked higher in the list of the top calorie contributors for men than women in the MRE XVII group and contributed greater proportions of the average energy intake of men than of women.

Because the entrees include a variety and often a combination of foods, they were individually ranked. However, if energy intakes from the individual entrees are collectively summed, entrees were the best providers of energy—providing 22%–23% of the energy intake within all test groups. Entrees also provided the majority of the mean protein intake for men eating the Concept ration (56%) and women and men eating the MRE XVII (58% and 59%, respectively). The entrees were still the best protein source for women in the Concept group, but they contributed only 42% toward the group mean intake of protein, most of the difference being made up by non-ration foods.

Vitamins & Minerals

Examining the top ration sources of vitamins and minerals reveals more differences between the rations than between women and men. Table 16 on the next page outlines the categories of ration foods that were the best sources of the problem nutrients. Savory spreads includes the cheese spreads and peanut butter. In the Concept group, cookies, the Nutrigrain Bar, and the chocolate pudding were categorized together. The category, crackers, breads, and snacks, includes the popcorn bar, the Hooah Bar, the E-bar, the flatbreads, and the sandwich crackers in the Concept ration. In the MRE XVII ration, the cheese curls, corn chips, MRE crackers, pretzel sticks, and tavern nuts were categorized with crackers, breads, and snacks.

The entrees together were important, although not necessarily top, providers of most of the vitamins and minerals tabulated. Overall, entrees contributed proportionally greater amounts of vitamins, minerals, and dietary fiber to women and men in the MRE XVII group than the Concept group. In the Concept group, the breakfast cereals provided more of the vitamin A, vitamin B_6, calcium, and iron intakes of the women than the men, while entrees and savory spreads contributed proportionally more of these nutrients to the men than the women in the group. In the MRE XVII group, the food categories ranked almost identically for women and men, although the proportional contributions to total nutrient intakes varied for some nutrients.

The Hooah Bars in the Concept ration (within the crackers, breads, and snack foods category) were the standout folate sources for that group, providing 16.4% of the total folate intake of the women and 21.6% of the folate intake of the men. The folate contribution of the Hooah Bars (40 μg to the female group and 67 μg to the male group) was almost four times what the top food contributors (MRE crackers and pound cakes) in the MRE XVII group provided.

Table 16. Top Ration Sources, as Food Categories, of Select Nutrients with Percentage of Total Intake.

	Women	Men
VITAMIN A		
Concept Group		
	Savory Spreads (24.9%)	Savory Spreads (36.1%)
	Breakfast Cereals (21.9%)	Entrees (15.1%)
	Cookies, Cereal Bars & Pudding (12.1%)	Breakfast Cereals (14.4%)
	Beverages (9.9%)	Beverages (10.0%); Cookies & Cereal Bars (10%)
MRE XVII Group		
	Savory Spreads (50.6%)	Savory Spreads (63.2%)
	Entrees (24.5%)	Entrees (19.2%)
	Beverages (15.1%)	Beverages (6.4%)
	Cookies, Cereal Bars & Pudding (2.4%)	Cookies (4.0%)
VITAMIN E		
Concept Group		
	Fruit (23.2%)	Fruit (28.7%)
	Crackers, Breads & Snacks (18,6%)	Crackers, Breads & Snacks (19.3%)
	Cookies, Cereal Bars & Pudding (15.8%)	Cookies & Cereal Bars (16.8%)
	Entrees (10.7%)	Entrees (10.9%)
MRE XVII Group		
	Entrees (52.0%)	Entrees (41.6%)
	Crackers, Breads & Snacks (13.3%)	Crackers, Breads & Snacks (19.8%)
	Savory Spreads (10.1%)	Savory Spreads (14.9%)
	Fruit (9.7%)	Fruit (7.9%)

Table 16. Top Ration Sources, as Food Categories, of Select Nutrients with Percentage of Total Intake.

	Women	Men
FOLATE		
Concept Group		
	Crackers, Breads & Snacks (22.8%)	Crackers, Breads & Snacks (27.2%)
	Cookies, Cereal Bars & Pudding (17.8%)	Beverages (18.1%)
	Entrees (11.9%)	Entrees (14.9%)
	Breakfast Cereals (10.3%)	Breakfast Cereals (12.1%)
MRE XVII Group		
	Entrees (36.2%)	Entrees (42.4%)
	Crackers, Breads & Snacks (17.0%)	Crackers, Breads & Snacks (19.9%)
	Cakes (6.7%)	Cakes (8.4%)
	Savory Spreads (5.9%)	Savory Spreads (7.8%)
VITAMIN B_6		
Concept Group		
	Breakfast Cereals (20.0%)	Savory Spreads (25.3%)
	Savory Spreads (19.0%)	Crackers, Breads & Snacks (17.0%)
	Crackers, Breads & Snacks (15.9%)	Entrees (16.4%)
	Cookies, Cereal Bars & Pudding (11.3%)	Breakfast Cereals (12.9%)
MRE XVII Group		
	Savory Spreads (40.3%)	Savory Spreads (45.8%)
	Entrees (20.9%)	Entrees (21.9%)
	Crackers, Breads & Snacks (17.8%)	Crackers, Breads & Snacks (19.6%)
	Beverages (9.4%)	Beverages (3.6%)
CALCIUM		
Concept Group		
	Beverages (19.7%)	Beverages (39.8%)
	Crackers, Breads & Snacks (19.2%)	Entrees (20.2%)
	Entrees (15.7%)	Crackers, Breads & Snacks (19.0%)
	Breakfast Cereal (10.8%)	Savory Spreads (5.4%)
MRE XVII Group		
	Crackers, Breads & Snacks (34.6%)	Crackers, Breads & Snacks (38.7%)
	Entrees (18.8%)	Entrees (17.0%)
	Savory Spreads (13.5%)	Savory Spreads (16.6%)
	Beverages (9.9%)	Beverages (8.1%)
IRON		
Concept Group		
	Entrees (20.8%)	Entrees (30.5%)
	Crackers, Breads & Snacks (18.6%)	Crackers, Breads & Snacks (21.2%)
	Breakfast Cereals (17.8%)	Cookies, Cereal Bars & Pudding (13.0%)
	Cookies, Cereal Bars, & Pudding (13.6%)	Fruit (7.6%)
MRE XVII Group		
	Entrees (35.4%)	Entrees (35.8%)
	Crackers, Breads & Snacks (28.6%)	Crackers, Breads & Snacks (31.0%)
	Cookies & Cereal Bars (9.3%)	Cookies & Cereal Bars (11.5%)
	Cakes (4.4%)	Cakes (5.5%)

Table 16. Top Ration Sources, as Food Categories, of Select Nutrients with Percentage of Total Intake.

	Women	Men
MAGNESIUM		
Concept Group		
	Entrees (23.7%)	Entrees (30.6%)
	Crackers, Breads & Snacks (15.8%)	Beverages (20.8%)
	Beverages (14.0%)	Crackers, Breads & Snacks (17.7%)
	Cookies, Cereal Bars & Pudding (8.5%)	Fruit (6.5%)
MRE XVII Group		
	Entrees (32.5%)	Entrees (32.9%)
	Crackers, Breads & Snacks (14.3%)	Crackers, Breads & Snacks (16.6%)
	Savory Spreads (12.8%)	Savory Spreads (15.1%)
	Cookies & Cereal Bars (10.0%)	Cookies (12.3%)
SODIUM		
Concept Group		
	Entrees (38.7%)	Entrees (47.1%)
	Crackers, Breads & Snacks (14.6%)	Crackers, Breads & Snacks (14.2%)
	Starchy Dishes (10.4%)	Starchy Dishes (13.5%)
	Meat Snacks (6.8%)	Cookies & Pudding (4.9%)
MRE XVII Group		
	Entrees (53.2%)	Entrees (52.8%)
	Crackers, Breads & Snacks (16.9%)	Crackers, Breads & Snacks (16.1%)
	Savory Spreads (7.7%)	Savory Spreads (9.3%)
	Starchy Dishes (5.2%)	Starchy Dishes (5.7%)
ZINC		
Concept Group		
	Entrees (34.3%)	Entrees (46.2%)
	Crackers, Breads & Snacks (9.7%)	Crackers, Breads & Snacks (10.8%)
	Cookies, Cereal Bars & Pudding (9.6%)	Meat Snacks (7.4%)
	Meat Snacks (9.6%)	Cookies, Cereal Bars & Pudding (7.0%)
MRE XVII Group		
	Entrees (59.8%)	Entrees (59.8%)
	Crackers, Breads & Snacks (11.4%)	Crackers, Breads & Snacks (10.9%)
	Savory Spreads (7.2%)	Savory Spreads (8.4%)
	Cookies & Cereal Bars (6.1%)	Cookies & Cereal Bars (7.7%)
DIETARY FIBER		
Concept Group		
	Fruit (30.7%)	Fruit (34.9%)
	Crackers, Breads & Snacks (21.9%)	Crackers, Breads & Snacks (23.5%)
	Entrees (11.5%)	Entrees (13.8%)
	Cookies, Cereal Bars & Pudding (9.2%)	Cookies, Cereal Bars & Pudding (9.2%)
MRE XVII Group		
	Entrees (30.6%)	Entrees (28.2%)
	Crackers, Breads & Snacks (21.1%)	Crackers, Breads & Snacks (26.4%)
	Fruit (13.0%)	Fruit (11.2%)
	Cookies & Cereal Bars (11.9%)	Cookies & Cereal Bars (14.2%)

Beverages were the top calcium sources for women and men consuming the Concept ration mainly because of the contribution of the Ergo Drink. The test formulation of the Ergo Drink provided for this study was fortified with calcium at a level of 439 mg per serving. As a result, the Ergo Drink contributed 81 g calcium to the average diet of women in the Concept group and 231 mg calcium to the diet of the men in the group.

Top-rated Foods

Table 17 presents, broken down by ration and gender group, the macronutrient distributions of the foods that received the 20 highest mean hedonic ratings. Note that ratings were not obtained for non-ration items. On average, these foods derived most of their energy from carbohydrate; 63%–67% of the mean energy content of the top 20 rated foods came from carbohydrate. Based on hedonic ratings recorded at the time of consumption, women tended to prefer higher carbohydrate foods than men. However, the gender differences depended on ration group assignment. In the Concept group, women gave their highest ratings to foods proportionately lower in fat than those of men, while in the MRE XVII group, men gave their highest ratings to foods relatively higher in protein compared to women.

Table 17. Macronutrient Distributions (As Percentage of Total Energy CONTENT) of the Top 20 Rated Items by Ration Group and Gender.

		Carbohydrate	Protein	Fat
Concept				
	Women	66.7%	7.0%	26.3%
	Men	62.9%	7.8%	29.3%
MRE XVII				
	Women	66.2%	6.8%	27.0%
	Men	63.6%	9.4%	27.0%

When nutrient intakes from only the top 20 rated foods in each respective gender- and ration-group are considered, these seeming preferences for specific macronutrients change and are more highly dependent on ration group assignment (see Table 18). While the top 20 rated foods of women in the Concept group contained, on average, a greater proportion of energy from carbohydrate than those of the men, the Concept group women derived a lesser proportion of their total energy intake from carbohydrate from these foods than did the men, but they derived more calories from protein and fat—a reversal of the food content pattern. In the MRE XVII group, the patterns of macronutrient distributions of intakes from the top 20 rated items were similar for women and men but the gender differences widened. Of group mean intake from their top 20 rated foods, women in the MRE XVII group derived a much

greater proportion of their energy from carbohydrate and lesser proportions of energy from protein and fat than did men in this ration group.

Table 18. Macronutrient Distributions (As Percentage of Total Energy) of INTAKES from the Top 20 Rated Items by Ration Group and Gender.

		Carbohydrate	Protein	Fat
Concept				
	Women	60.6%	8.0%	31.3%
	Men	65.1%	6.4%	28.5%
MRE XVII				
	Women	70.2%	5.5%	24.2%
	Men	60.6%	8.7%	30.7%

Tables 19 and 20 present (for the Concept and MRE XVII rations, respectively) the rankings of the top 20 individual foods based on hedonic ratings. Overall, women seemed to be more opinionated in their ratings than were men; women provided the highest and lowest ratings for any foods in both ration groups. Most of the top-rated foods for both women and men in both ration groups were candies and other sweet foods. Nevertheless, the top-rated items were not the top energy contributors, providing at most (for men in the MRE XVII group) 24.4% of the total energy intake. In contrast, the 20 individual foods providing the most energy (see Tables 12 and 13) contributed, respectively, 46%, 55%, 59%, and 50% of the total energy intake in the diets of women and men in the Concept group and women and men in the MRE XVII group. Conversely, the twenty foods consumed in the greatest gram weight quantities (data not presented) accounted for 33%–43% of total energy intake.

The top rated foods were not the top energy contributors because many of the foods that received top ratings were consumed by relatively few individuals. Some of the items highly rated by a few subjects in the Concept group were from the MRE XVII ration or vice versa. Although the test volunteers were instructed to only consume food from their assigned ration, a few individuals did trade with the other ration group for items which were recorded and rated. Three of the 4 foods with a mean rating of 9 from women in the Concept group were foods from MRE XVII (granola bar, pretzel sticks, and M&Ms); however, only 1 or 2 women rated these items. The only foods with mean ratings of 9 from women or men in the MRE XVII group were from the Concept ration (Cheddar Goldfish, Nutrigrain Cereal Bar, shortbread cookie, chocolate pudding, apple toaster pastry, and Nutter Butter Cookies); but, again, only 1 or 2 subjects in the MRE XVII group rated each of these foods. M&Ms from MRE XVII received a mean rating of 8.5 from 3 men in the Concept group, while 4 foods from the Concept ration (Nutter Butter cookies, cheese and crackers, chocolate mint cookies, and the caramel popcorn bar) received solitary ratings that would have placed them in the top 20 in the MRE XVII group had all rated foods been listed.

Table 19. Energy Contribution of Top 20 Rated Items in Assigned Ration by Gender, Concept Group.

WOMEN						MEN					
FOOD ITEM	Rating *Mean*	Energy *Mean kcal*	% total Energy	Consumers* *n*	Consumers* %	Food Item	Rating *Mean*	Energy *Mean kcal*	% total Energy	Consumers* *n*	Consumers* %
Charms	9.00	1.97	0.1%	4	15.4	Ranchero Sauce	8.70	9.15	0.3%	10	38.5
Cheddar Goldfish	8.69	32.19	1.5%	15	57.7	Nutter Butter Cookies	8.48	43.90	1.6%	21	80.8
Sugar	8.60	8.76	0.4%	8	30.8	Fig Bar	8.32	29.05	1.1%	12	46.2
Cream Substitute	8.60	5.26	0.3%	6	23.1	Beef Stick	8.25	20.55	0.8%	24	92.3
Tabasco Sauce	8.57	.02	0.0%	6	23.1	Chocolate Pudding	8.18	20.46	0.8%	14	53.8
Chocolate Pudding	8.53	23.96	1.1%	14	53.8	Toaster Pastry, Apple	8.10	100.81	3.7%	21	80.8
Lorna Doone Cookies	8.50	14.67	0.7%	13	50.0	Pineapple	8.03	51.46	1.9%	23	88.5
Beef Stick	8.39	24.08	1.2%	18	69.2	Peaches	8.02	35.30	1.3%	22	84.6
Applesauce	8.28	28.25	1.4%	20	76.9	Tuna Salad	8.01	29.06	1.1%	14	53.8
Peaches	8.26	26.75	1.3%	19	73.1	Grape Beverage Base	8.00	15.86	0.6%	13	50.0
Jalapeno Cheese Spread	8.21	21.30	1.0%	14	53.8	Nutrigrain Cereal Bar	8.00	11.91	0.4%	11	42.3
Nutter Butter Cookies	8.19	34.68	1.7%	13	50.0	MRE Gum	8.00	.24	0.0%	3	11.5
MRE Lemon Tea	8.18	21.12	1.0%	15	57.7	Jalapeno Cheese Spread	7.99	32.78	1.2%	18	69.2
Chow Mein Noodles	8.10	19.45	0.9%	15	57.7	MRE Cocoa	7.96	13.88	0.5%	7	26.9
Grape Beverage Base	8.08	16.86	0.8%	9	34.6	Skittles	7.94	23.47	0.9%	9	34.6
Orange Beverage Base	8.08	11.05	0.5%	7	26.9	Tabasco Sauce	7.93	.13	0.0%	13	50.0
Cherry Beverage Base	8.08	11.93	0.6%	8	30.8	Vanilla Pound Cake	7.93	70.53	2.6%	20	76.9
Potato Sticks	8.06	22.04	1.1%	13	50.0	Mixed Fruit	7.91	38.45	1.4%	23	88.5
Cheese & Crackers	8.04	19.51	0.9%	14	53.8	Lemon Poppy Cake	7.89	53.17	2.0%	17	65.4
Lemon Beverage Base	8.00	4.04	0.2%	5	19.2	Pears	7.86	37.67	1.4%	22	84.6
Sum of Top 20			**16.7%**						**23.6%**		

* The hedonic ratings for foods rated by few individuals (especially when rated by < 6 subjects) should be interpreted with caution.

Table 20. Energy Contribution of Top 20 Rated Items in Assigned Ration by Gender, MRE XVII Group.

WOMEN						MEN					
Food Item	Rating *Mean*	Energy *Mean kcal*	% total Energy	Consumers* n	Consumers* %	Food Item	Rating *Mean*	Energy *Mean kcal*	% total Energy	Consumers* n	Consumers* %
MRE M&Ms	8.56	30.76	1.7%	10	35.7	Pineapple Pound Cake	8.43	17.55	0.7%	22	26.8
MRE Granola Bar	8.36	45.67	2.5%	17	60.7	MRE M&Ms	8.35	28.08	1.2%	38	46.3
Vanilla Caramels	8.29	7.21	0.4%	7	25.0	Mixed Fruit	8.24	18.61	0.8%	49	59.8
Jolly Rancher Candies	8.28	30.44	1.7%	14	50.0	Beef Ravioli	8.18	37.42	1.5%	46	56.1
Potato Sticks	8.21	15.41	0.8%	12	42.9	Grilled Chicken Breast	8.17	18.21	0.8%	47	57.3
Pineapple Pound Cake	8.20	8.92	0.5%	5	17.9	Peaches	8.16	27.79	1.1%	59	72.0
Pretzel Sticks	8.17	23.74	1.3%	19	67.9	Vanilla Pound Cake	8.16	45.39	1.9%	49	59.8
Skittles	8.17	27.34	1.5%	9	32.1	Cheese Tortellini	8.12	52.13	2.1%	59	72.0
Tootsie Roll	8.17	9.58	0.5%	6	21.4	Vanilla Caramels	8.11	6.07	0.3%	20	24.4
Cheese Spread	8.10	14.96	0.8%	11	39.3	Tabasco Sauce	8.05	0.36	0.0%	56	68.3
Fig Bar	8.10	57.63	3.1%	20	71.4	Pasta w/Vegetables	8.04	39.42	1.6%	48	58.5
Peanut Munch Bar	8.08	43.82	2.4%	19	67.9	Pineapple	8.04	20.11	0.8%	58	70.7
Mixed Fruit	8.06	12.47	0.7%	13	46.4	Cheese Spread	8.01	37.73	1.6%	55	67.1
Peaches	8.05	35.30	1.9%	22	78.6	Pears	8.00	1.42	0.1%	7	8.5
Pork Chow Mein	8.00	9.70	0.5%	5	17.9	Lemon Pound Cake	7.96	46.94	1.9%	45	54.9
Orange Pound Cake	8.00	4.96	0.3%	2	7.1	Fig Bar	7.96	65.26	2.7%	66	80.5
Tabasco Sauce	7.95	0.05	0.0%	12	42.9	Cherry Beverage Base	7.96	24.50	1.0%	41	50.0
Applesauce	7.94	23.74	1.3%	22	78.6	Grape Beverage Base	7.96	26.91	1.1%	41	50.0
Jam	7.88	5.13	0.3%	8	28.6	Applesauce	7.95	22.05	0.9%	59	72.0
MRE Gum	7.87	12.85	0.7%	23	82	Jalapeno Cheese Spread	7.93	47.86	2.0%	56	68.3
Sum of Top 20			**22.9%**						**24.1%**		

* The hedonic ratings for foods rated by few individuals (especially when rated by < 6 subjects) should be interpreted with caution.

Non-Ration Foods

Tables 14 and 15 on pages 31–32 show that for many subjects, non-ration foods provided a significant amount of energy. Seventeen of the top 50 calorie contributors to the diets of individual women in the Concept group were non-ration foods. Seven non-ration foods made the list for men in the Concept group, while 16 and 14 of the foods on the top 50 lists of energy contributors for women and men, respectively, in the MRE XVII group were non-ration items.

A two-way MANOVA indicated there were differences between the gender and ration groups in the proportional contributions of non-ration foods toward total intakes of energy and many nutrients. Subsequent univariate analyses and independent t-tests (if indicated by a significant interaction effect) were performed to identify where the differences occurred. (See Table 21.)

Figure 4. Proportional energy intakes by source

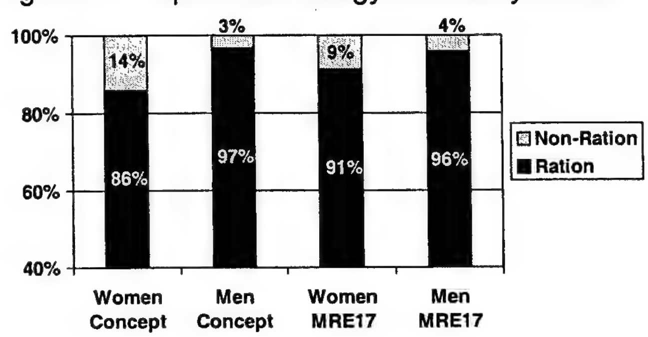


Figure 4 illustrates the average contribution of non-ration foods to the diets of women and men in the two ration groups. On average, women consumed more energy and derived a greater proportion of their total energy intake from non-ration foods than men ($p < .0001$). The average diet of women in the Concept group obtained 14.0 ± 13.8% of total energy from non-ration foods, and 8.6 ± 6.7% of energy consumed by women in the MRE XVII group came from non-ration foods. Although the absolute amount of energy from non-ration foods was greater for women in the Concept group (295 ± 266 kcal) compared to the MRE XVII group (165 ± 119 kcal) ($p =.003$), the proportions of total energy from non-ration foods for women in the two ration groups were not significantly different. In contrast to women, men in the Concept group only obtained 3.3 ± 3.5% of total calories, and men in the MRE XVII group obtained 4.2 ± 5.8% of total calories from non-ration foods.

Table 21 presents the proportional intakes of select nutrients from non-ration foods. The proportion of total intakes from non-ration foods for all nutrients was higher by the women than the men in each ration group ($p \leq .0001$). Non-ration food was an important contributor of folate for women in both ration groups, providing an average of 16% of their total folate intake. These foods also contributed significant shares of total calcium, magnesium, potassium, and zinc intakes. Overall, non-ration foods provided relatively more carbohydrate than fat; however, they were relatively low in dietary fiber.

Table 21. Contribution of Non-ration Foods to Total Energy and Nutrient Intakes.
*(mean proportion ± standard deviation)**

	Concept		MRE XVII		Comparisons	
	Women (n=26)	Men (n=26)	Women (n=28)	Men (n=82)	Ration ($p\leq$)	Gender ($p\leq$)
Energy (kcal)	284 ± 267	88 ± 90	159 ± 135	94 ± 133	.030	.0001
%Total Carbohydrate	**14.1** ± 12.3	**4.5** ± 4.9	**11.2** ± 7.7	**5.5** ± 7.8	ns	.0001
%Total Protein	**14.2** ± 17.2	1.3 ± 2.6	6.9 ± 12.7	2.4 ± 4.8	ns	.0001
%Total Fat	12.3 ± 16.4	1.5 ± 2.8	6.3 ± 11.6	2.2 ± 4.0	ns	.0001
%Total Cholesterol	**14.8** ± 19.1	1.1 ± 2.8	6.2 ± 18.7	2.2 ± 4.8	ns	.0001
%Total Fiber	10.9 ± 17.4	1.8 ± 4.0	7.9 ± 9.5	1.5 ± 3.0	ns	.0001
VITAMINS						
%Total Vitamin A	10.2 ± 15.3	0.9 ± 2.8	5.2 ± 14.8	2.8 ± 7.3	ns	.001
%Total Thiamin	6.7 ± 8.4	0.8 ± 1.4	5.2 ± 8.0	1.3 ± 2.4	ns	.0001
%Total Riboflavin	12.3 ± 15.2	2.3 ± 2.4	**10.2** ± 9.7	**4.3** ± 7.5	ns	.0001
%Total Niacin	10.0 ± 12.2	1.3 ± 2.7	6.5 ± 12.5	1.5 ± 3.4	ns	.0001
%Total Folate	**15.5** ± 17.2	3.2 ± 3.1	**16.4** ± 15.0	**6.1** ± 9.1	ns	.0001
%Total Vitamin B_6	7.9 ± 9.9	1.2 ± 2.3	5.6 ± 12.2	1.0 ± 1.9	ns	.0001
%Total Vitamin B_{12}	**19.1** ± 26.8	2.7 ± 7.3	**9.5** ± 19.3	3.4 ± 8.2	ns	.0001
%Total Vitamin C	5.1 ± 10.5	0.2 ± 0.7	5.7 ± 13.0	0.5 ± 1.4	ns	.0001
%Total Vitamin E	13.3 ± 17.1	1.8 ± 4.9	6.3 ± 12.9	0.8 ± 1.8	.014	.0001
MINERALS						
%Total Calcium	**14.3** ± 21.1	1.7 ± 2.4	**9.1** ± 8.8	**5.2** ± 11.3	ns	.0001
%Total Iron	9.9 ± 14.5	1.7 ± 2.4	7.0 ± 8.9	2.1 ± 3.8	ns	.0001
%Total Magnesium	**17.9** ± 19.6	3.0 ± 2.7	**10.6** ± 9.0	4.0 ± 6.0	ns	.0001
%Total Potassium	**20.6** ± 20.7	**4.2** ± 4.7	**13.3** ± 13.0	**5.5** ± 8.8	ns	.0001
%Total Sodium	10.8 ± 11.6	2.0 ± 2.8	7.5 ± 11.6	3.0 ± 7.1	ns	.0001
%Total Zinc	**17.8** ± 22.3	2.1 ± 2.5	6.4 ± 8.8	2.6 ± 4.5	.003	.0001

*Bolded values indicate mean proportions that are equal to or greater than the proportion of total energy.

Although non-ration foods contributed appreciably to the mean intake of the test groups, consumption of non-ration foods was not a universal practice. Table 22 outlines the number of subjects reporting non-ration foods and the number of subjects in which non-ration foods comprised a large proportion of total energy intake. Not all subjects reported non-ration item consumption during the study period. This explains the relatively large standard deviations of the proportional intakes. More of the women than men reported consumption of non-ration foods and more women reported non-ration

intakes that represented at least 20% of total energy intake. One woman in the Concept group obtained almost 49% of her total energy intake from pogey bait.

Table 22. Subjects Reporting Intake of Non-ration Foods.
(number of subjects with proportion of group in parentheses)

	Reported non-ration foods	Obtained ≥20% total calories from non-ration foods
Concept Women (n=26)	24 (92%)	9 (35%)
Concept Men (n=26)	19 (73%)	0
MRE XVII Women (n=28)	27 (96%)	2 (7%)
MRE XVII Men (n=82)	52 (63%)	1 (1%)

FOOD WASTE

Mean energy intakes from just the test rations were compared to the average energy provision of the ration menus provided to determine, in general, the amount of rations wasted. Mean daily energy intakes from the ration were 1673 kcal and 2700 kcal less than available for women in the Concept and MRE XVII groups, respectively. Men failed to consume a mean of 882 kcal/d in the Concept ration and 2057 kcal/d in the MRE XVII ration. Female soldiers in the Concept group consumed approximately 52% of the 3481 kcal available in the ration, whereas male soldiers in the Concept group consumed 75% of the energy in the ration. Women provided the MRE XVII ration consumed only 38% of the 4359 kcal available from the MREs and shelf-stable bread, while men provided the MRE XVII ration and bread consumed 53% of the energy in the ration provision.

MRE CRACKER ANALYSIS

The crackers in the MRE XVII ration and the Concept ration procured from the Defense Supply Center Philadelphia were not fortified according to the military specification. This was suspected when the Nutrition Facts panel on the product label claimed a calcium content of 0% of the Daily Value and the ingredients listing on the label failed to list a calcium compound. A sample of crackers from the MRE lot used in this study was sent to a laboratory for chemical analysis, confirming that the calcium content, as well as the iron content, were much lower than they were supposed to be.

Calcium and iron intakes of subjects in the MRE XVII ration group were reanalyzed using both the specification levels and the actual cracker composition data rather than the average product data used in the first analyses presented above. The calcium content data (107 mg/pkg) used to calculate the first, generalized intake value was a

mean of analytical data from the 3 cracker manufacturers. This value was already lower than the calcium content expected if the crackers had been fortified according to the 1994 engineering change regarding calcium fortification of the crackers (210 mg/pkg). The actual calcium content of the crackers provided during this study (based on duplicate analyses of 2 samples) was 77 mg/pkg. Results of both reanalyses are presented in Table 23 on the next page.

Despite an adjustment in nutrient data for only one food in the diet, the recalculated mean calcium intakes of women and men consuming the MRE XVII were 5% to 6% lower than intakes calculated using average product data and were 19% to 22% lower than what they could have been had the crackers been fortified according to the specification. The proportion of women with calcium intakes less than 70% of the Adequate Intake (AI) value of 1000 mg increased by 1/26 in the Concept group and 4/28 in the MRE XVII group when analyses were made with the actual calcium content of the cracker rather than the specification level; however, 22 additional men out of 82 in the MRE XVII group are categorized with diets less than 70% of the AI for calcium.

Table 23. Calculated Mean Calcium and Iron Intakes and Proportion of Subjects with Low Intakes Using Specification (Spec) and Actual Cracker Composition Data.

	Calcium		Iron	
	Cracker Data Spec → Actual *Mean Intake*	Cracker Data Spec → Actual *# <70% AI*	Cracker Data Spec → Actual *Mean Intake*	Cracker Data Spec → Actual *# <EAR*
WOMEN				
Concept	568 → 532	19/26 → 20/26	14.2 → 13.9	3/26 → 3/26
MRE XVII	536 → 435	23/28 → 27/28	11.9 → 11.0	3/28 → 4/28
MEN				
Concept	716 → 689	13/26 → 13/26	15.9 → 15.7	0/26 → 0/26
MRE XVII	733 → 569	38/82 → 60/82	15.6 → 14.2	1/82 → 1/82

Iron intakes of women and men in the MRE XVII group were 7% and 9% lower, respectively, when calculated with the actual cracker data than with the specification iron value. Compared to intakes based on the theoretical specification cracker data, only one additional woman had an iron intake less than the gender-specific Estimated Average Requirement [(EAR) 8.1 mg for women and 6 mg for men]. Even if the crackers had been fortified at the product specification level, 23 of the 26 women in the Concept group and 26 of the 28 women in the MRE XVII group would have had a mean iron intake less than their Recommended Dietary Allowance.

DISCUSSION

In accordance with the Nutritional Standards for Operational Rations in AR 40-25 (10-11), operational rations are designed with military recommended dietary allowance levels of specified nutrients in an energy provision of at least 3600 kcal. However, nutrients are not evenly dispersed among all ration components. Theoretically, an individual would have to consume 3600 kcal to meet the allowances for the nutrients specified in the regulation. But most women and many men do not consume nor require 3600 kcal per day. Although it may be possible for an individual with an energy requirement less than 3600 kcal to selectively consume the most nutrient-dense items to meet their nutrient needs without exceeding their energy requirement, this was not demonstrated during this study. The results of this study support the findings of the few previous field studies with women and confirm that women are unable to meet some of their nutrient needs within the nutrient densities of the current MRE.

As in previous field studies (1), energy intakes did not meet MRDA levels. The mean energy intakes of both women and men were well below the gender-specific MDRIs for energy established for moderate levels of activity, whereas the energy expenditure data from the subgroup of subjects indicate activity levels during the training exercise would be categorized as heavy.

Not surprisingly, the female soldiers in this study had average energy intakes lower than the men. This has been found for every military study, whether in the field or in garrison, that included both women and men (3, 12, 20, 22, 30, 33, Hirsch, unpublished) and agrees with the generally lower energy requirements of women (27). In all studies in which the mean energy intake of female subjects was lower than the female MRDA for energy, the mean energy intakes of men were also less than the male MRDA (3, 12, 33). However, the differences in mean energy intakes between women and men (596 kcal in the Concept group and 592 kcal in the MRE XVII group) in the current study were smaller than in all but one previous study. Only in the group of subjects provided a high-carbohydrate test ration during a study by Hirsch and colleagues (unpublished data) did women come as close to the energy intakes of the men (mean difference of 502 kcal) as did the women in the current study.

The low energy intakes observed during this study cannot solely be attributed to the ration. The same environmental and situational factors identified in numerous field tests of the rations (21) also contributed to underconsumption. The continuous operation of the combat support hospital dictated that many personnel worked extended hours or split shifts and the around-the-clock mass casualty drills prevented scheduled meals. However, the availability of bulk beverages provided by the field kitchen (a typical practice for this type of unit but not all field units) enhanced energy and carbohydrate intakes of many individuals.

There have been a couple of recent field studies with female subjects, both with U.S. Army Reserve combat support hospital personnel. M. Rose and colleagues reported (30) mean energy intakes of 2343 kcal/day for women and 3056 kcal/day for men during a hot-weather exercise in which two hot meals plus a MRE lunch were provided each day. As in the current study, these investigators found no statistically significant difference between the energy intakes of women (35.4 kcal/kg) and men (39.1 kcal/kg) when energy intakes were normalized to body weight. These levels of energy intake are significantly higher than those of the current study, likely because of scheduled meals and the availability of fresh foods during the earlier study.

The results of the present study suggest that women consuming operational rations in a field setting underconsume energy to a similar, if not lesser, degree as men. Assuming the energy expenditure measures by DLW on the subgroup of women and men over the entire 11-day FTX describe the actual energy needs of all subjects during the 7-day dietary data collection period, the energy intakes of women in the Concept and MRE XVII groups covered approximately 76% and 66%, respectively, of their requirements, while energy intakes of men in the Concept and MRE XVII groups provided roughly 68% and 60%, respectively, of their requirements. The energy expenditure data suggests mean daily energy deficits were on the order of 800 kcal for women and 1400 kcal for men. This is the first study to quantify the energy deficits of female soldiers during field training, although the deficits observed in the men are consistent with the findings of previous field studies of men (25).

The inability to consume adequate energy was not due to an inadequate supply of food. Over half of the energy in the rations available to women was not consumed, while men wasted almost 42% of the energy available to them in the rations. Men in the current study consumed slightly more of the energy in the ration provisions than men in a study reported by Lester et al. (23). In the current study, men consumed 75% and 53% of the energy provision in the Concept and MRE XVII rations, respectively. In the Lester study, men subsisting on the SEP (a test ration consisting of developmental items) or MRE VIII rations consumed 67% and 49%, respectively, of the energy content of the rations. Food waste in the 30-day MRE study was almost identical to the current 7-day study. In the 30-day MRE study, energy intake constituted 55% of the energy provided by the three MREs plus two pouch breads each day.

The finding that women consumed less of the available energy in the rations than men agrees with their greater energy intake from non-ration foods. Because of the location and nature of the FTX, outside foods could be obtained, at least by some personnel. However, most of the non-ration items consumed by female personnel seemed to have been brought with them to the field, while most men seemed to rely on serendipitous opportunities to obtain non-ration items. That women preplanned their non-ration consumption may be an indicator of pre-existing notions of the acceptability of field rations.

Non-ration foods did contribute more than empty calories—they also provided some important nutrients. Although the proportion of nutrient intake obtained was less than the proportion of total energy obtained from non-ration foods for most nutrients, the contribution toward total vitamin E, riboflavin, folate and vitamin B_{12} was commensurate with the energy provision.

There was less energy waste in the Concept group (~37%) than in the MRE XVII group (~51%), in part because there was less available in the Concept ration. The MRE XVII ration tested included a forced issue of three shelf-stable breads (540 kcal), which was not projected during study planning. Still, the expected MRE ration (~3800 kcal) would have provided more energy than the Concept ration (3481 kcal). The greater energy intakes from the Concept than the MRE XVII ration agrees with previous ration tests that have consistently found the new or test ration to fare better than the already fielded MRE (12, 23, 28).

The results of this study show that the Concept ration effectively increased energy and carbohydrate intakes in comparison to those observed in the MRE XVII group. The results demonstrate that troops will consume a diet with a macronutrient composition similar to that of the ration provided even when a significant proportion of the ration is not consumed. The proportions of energy derived from carbohydrate were within 2% of calories in the assigned ration, except for women in the MRE XVII group. Women in the MRE XVII group derived a greater proportion of their energy from carbohydrates than provided by the ration because of the significant consumption of high-carbohydrate non-ration foods. This finding corroborates the 4-day study conducted by Hirsch and colleagues at Camp Parks (unpublished) in which the diets of three groups of troops fed rations varying in macronutrient content were almost identical to the compositions of the rations offered.

The relatively low carbohydrate intakes seen in this study, especially in the MRE XVII group, potentially would not be enough to support sustained physical activities. Adequate dietary carbohydrates are important to replenish muscle glycogen stores and maintain blood glucose levels. A carbohydrate intake of 6 g/kg body weight is considered sufficient for persons exercising for no more than 1 hour per day (6), while sports nutritionists (26) recommend a daily diet of at least 8 g/kg body weight for individuals working hard for several hours each day. Although carbohydrate intakes were higher in the Concept group than the MRE XVII group, they averaged only 5.2 g/kg for both women and men in the Concept group. Mean carbohydrate intakes in the MRE XVII group were only 4.3 g/kg for women and 4.1 g/kg for men.

Compared to earlier versions of the MRE, changes to the ration have already enhanced carbohydrate consumption. Carbohydrate intakes by men in the MRE XVII group were higher than most of those observed in prior studies of subjects consuming earlier versions of the MRE. In the study by Lester et al. (23), men provided the MRE VIII

consumed 217 g carbohydrate, which comprised 44% of their total energy intake. Thomas et al. reported carbohydrate intakes of 281 g in the men consuming the MRE XII for 30 days (34), while the men in the current study consuming the MRE XVII had a mean carbohydrate intake of 324 g.

Protein intakes in both ration groups were likely marginal, although averaging more than 0.8 g/kg body weight (the Recommended Dietary Allowance for protein). Nitrogen balance (in essence, protein balance) is influenced by energy intake—the lower the energy intake, the higher dietary protein intake must be to achieve zero nitrogen balance (2, 8). Given that most individuals seemed to have been in negative energy balance during the FTX, protein intakes may not have been sufficient to maintain nitrogen balance. Efforts to enhance energy and carbohydrate intakes need to ensure that protein provisions are not compromised.

This study confirms that the nutrient-to-energy density of field rations is not adequate to meet the needs of women. Most of the differences in nutrient intakes between women and men were due to the expected differences in energy intakes. Men consumed greater absolute amounts of most reported macronutrients, vitamins, and minerals. However, when nutrient intakes are normalized for energy intake (i.e., nutrient per 1000 kcal) or body size (i.e., nutrient per kg body weight), there are very few gender differences. In other words, the diets of women and men within each ration group were qualitatively similar. Primarily because women consumed less energy than men, greater proportions of women than men ($p<0.01$) in the Concept group failed to meet estimated nutrient requirements for folate, vitamins B_{12} and C, calcium, and magnesium. Greater proportions of women than men in the MRE XVII group failed to meet their estimated requirements for thiamin, vitamins B_6, B_{12}, and E, and calcium, iron, magnesium, and zinc. Even though women in the Concept group had diets with a greater mean iron density than men, their mean iron intake was the same as men. But because their iron requirement is higher, more of the women (27%) than the men (0%) consumed less than 70% of the RDA or MRDA. Mean iron intake by women receiving MRE XVII was much lower than the Military Recommended Dietary Allowance.

Although previous field studies of women (12, 30) have found intakes of vitamin B_6 to be less than the MRDA, only a small proportion of women in this study were at risk of inadequate B_6 intakes. The problem nutrients in the diets of the women are not strictly nutrients of concern for women. Mean intakes of calcium and folate were low for men and women in both ration groups. In addition, the men and women subsisting on MRE XVII were at risk for inadequate intakes of magnesium and possibly zinc. Thus, the nutrient densities of the field rations tested are not adequate at the levels of energy intake observed in these women (and some men). These results indicate that supplementation or further fortification of ration components is warranted. Candidates for fortification would be the foods consumed in at least modest quantities by a majority of

female soldiers. The MRE cracker is a good example of how a single, widely-consumed, fortified food can positively impact nutrient intake.

Comparing nutrient intakes to less than 70% of an allowance is an informative benchmark, but does tend to overestimate the true proportion of the group or population at risk of inadequate intake. Although the use of fixed cutoff points (i.e., a percentage of the MDRI or RDA) may not accurately predict the actual prevalences of inadequate intakes, there is no reason to believe the errors of prediction would be different for the different test groups. Therefore, the use of fixed cutoff points can be used to compare the relative adequacy of nutrient intakes of women and men or from one ration versus another.

Results of this study would seem to indicate that, when diets are *ad libitum*, intakes of most nutrients are directly related to energy intakes. However, there were fewer differences in absolute nutrient intakes between women and men in the Concept ration group than in the MRE XVII group, despite almost identical differences in energy intakes. This may be because there were fewer choices in the Concept ration than in MRE XVII. Thus, total energy intake or gender differences in food preferences have less influence on nutrient intakes as food choices are reduced.

Nevertheless, intakes of cholesterol, vitamins C and E, and iron were more influenced by specific food choices than total energy intake. For example, the greater cholesterol intakes by men, combined with the greater cholesterol densities of the diets of men, indicate the men consumed relatively more meats and cheese spreads than women. These are the primary animal food sources in the rations, which are the only sources of cholesterol. In contrast, the greater riboflavin density of the diets of women in the Concept group suggests a relatively greater selection than men of the cereal with milk.

Reporting of vitamin and mineral intakes from the Concept ration is done, not to describe deficiencies of a test ration that did not need to be nutritionally complete, but to present the nutritional considerations needed before finalizing a ration system based on these concepts. Although the Concept ration was not designed as a nutritionally complete ration, it was better than MRE XVII in providing some important nutrients because of the incorporation of highly fortified products. Many of the concept items or commercial products tested during this study were fortified with select vitamins or minerals and significantly contributed toward total nutrient intakes. For example, the breakfast cereals (oatmeal and Frosted Flakes) provided, on average, 18% of the iron in the diets of women in the Concept group. The benefit of fortification is also evident in the higher mean folate intakes of women and men in the Concept group versus the MRE XVII group. In addition, the Ergo Drink used in this study was fortified with calcium at the level of 439 mg per serving and was a highly acceptable product. Had this beverage been in menus other than breakfast, calcium intakes of subjects in the Concept ration group

likely would have met the allowance. Nevertheless, many of the new concept items being tested, while popular and able to promote energy and carbohydrate intakes, were not nutrient-dense foods.

The benefit of fortification is further evidenced by the generous mean intakes of thiamin, riboflavin, niacin and ascorbic acid (vitamin C) due to the enrichment and fortification of popular ration components. Failure of the MRE crackers to be fortified with calcium and iron, as mandated in the military specification, negatively impacted the dietary quality of numerous individuals. After pouch bread, the crackers were the most frequently consumed item; 133 of the 162 subjects ate crackers at least once during the study, with an average of 6.6 eating occasions. Niacin fortification, however, may be too generous. Fifteen men in the MRE XVII group reported diets with niacin contents exceeding 35 mg, the Tolerable Upper Intake Level established by the National Academy of Sciences Subcommittee on Upper Reference Levels of Nutrients (16).

Generous use of items with commercial item descriptors or performance specifications may not be feasible if the nutritional content of the fielded ration is to be guaranteed. There is no control over product formulation, enrichment or fortification levels, or processing losses with commercial products and limited control over items with performance specifications. Between the time of menu planning and procurement, manufacturers often change product formulations or their ingredient sources, which can drastically alter the nutrient composition of items. In addition, the same menu item from different manufacturers can have markedly different formulations and nutrient contents and the reliability of the nutrient data provided by different manufacturers varies greatly. For example, there were three manufacturers of the MRE cheese tortellini in tomato sauce, a performance specification item, for MRE XVI. One manufacturer provided nutrient data obtained from laboratory analysis, one provided nutrient data derived from computer analysis, and one would provide only their label declaration information. The reported energy contents of their products ranged from 220 to 354 kcal per serving, a variation of 61%. The composition data for the macronutrients, vitamins, and minerals (if provided) varied by as much. The manufacturer providing label declaration information for the MRE XVI item apparently changed the product formulation, because the label information on the MRE XVII item procured for this study from that manufacturer was different.

The values used to analyze nutrient intakes for this study were means of in-house laboratory and manufacturer's data, which would be "theoretical" average values of newly manufactured products. The nutrient data available, as well as the Nutritional Standards for Operational Rations and product specifications, do not account for the storage losses of nutrients, which can be considerable. The data reported for this study are, therefore, reasonable estimates of nutrient intakes from newly manufactured rations, but would not necessarily reflect nutrient intakes at the time of consumption of rations stored for 2 or 3 years. Although some of the differences in nutrient intakes observed between ration

groups may be due to differences in the completeness or validity of the nutrient data for items in the two rations, nutrients with missing values for more than a very few foods were not reported.

Dietary intakes of folate, vitamin B_6, and zinc were often not calculated for ration studies because of inadequate nutrient data, or when intakes of these nutrients have been calculated, low intakes have been attributed to incomplete nutrient data. The nutrient database used to calculate nutrient intakes for this study had no missing values for these nutrients, and the majority of values were derived from analytical data. Therefore, intakes of at least vitamin B_6 and zinc were low because the ration provisions were low. For folate, dietary intakes were low but probably not as low as the estimations would indicate. There is general agreement that nutrient database values based on traditionally used methods for food folate analysis underestimate the true content by 20 to 50%, depending on the product. Data presented at the 22nd National Nutrient Data Bank Conference revealed that estimated folate intakes derived from analyses of composite diets by a newly-developed trienzyme procedure were an average of 35.4% higher than when analyzed with the standard method. The increases ranged from 10.1% to 94.2%, depending on the specific composite analyzed (14). "Adjusting" folate intakes calculated for the current study by the average percentage increase measured by the trienzyme method would yield 329 μg and 420 μg for the women and men, respectively, in the Concept ration group, and 199 μg and 242 μg for the women and men, respectively, in the MRE XVII group. Therefore, based on the data currently available, except for men in the Concept group, mean folate intakes were indeed low.

As of 1 January 1998, all enriched cereal grains (i.e., enriched bread, pasta, flour, breakfast cereal, and rice) have to be fortified with 1.4 mg folic acid per kilogram of grain (13). Although the rations for this study were procured in March 1997, many of the food items in MRE XVII, as well as the Concept ration, already were formulated with enriched ingredients. Folate intakes for this study were based on the folate content of the products received and, therefore, reflect some of the benefit of the new fortification law. Based on the foods that would increase in folate content once all MRE items reflect the mandated fortification levels, only modest further improvement in folate intakes would be expected solely because of the federal fortification requirement. Any great increase in folate content of the ration would need to be achieved by incorporation of additional good sources of folate or select fortification of military specification items. Many of the test items in the Concept ration, especially the Hooah Bar, the ErgoDrink, and the breakfast cereals, were excellent sources of folate and could enhance the folate provision of the MRE.

If subjects were trying to selectively consume the most nutrient-dense items from the ration, they may have tried to utilize label information to do so. MRE XVII was the first ration procurement in which the Nutrition Facts panel was printed on most item packages. Additionally, MRE XVII was the first ration to include additional nutrition

information on some of the entree, rice and fruit boxes. However, the information was often inaccurate or misleading. For example, the iron content of the crackers should be at least 1.5 mg per serving. However, the analytical laboratory measured only 0.79 mg per serving, far below the 10% Daily Value declared on the label and much less than would be expected if the manufacturer used enriched flour as mandated in the specification.

Although the table of fortified items that appears on some of the new MRE fruit and starch boxes notes the MRE Beverage Base as fortified with calcium, the calcium content of the MRE Beverage Base is only 6.36 mg per serving. This represents only 0.8% of the MRDA of 800 mg or 0.6% of the RDA of 1000 mg—hardly enough to be considered a good source of calcium. Calcium is added to the Beverage Base as an anti-caking agent to keep the product free pouring, not for nutrient fortification. If women consume the MRE beverage base thinking they are helping their calcium intake, they may be consuming unwanted or unneeded calories without a calcium benefit.

Obviously, 7 days of low intake would not lead to nutrient deficiencies in well-nourished individuals. Longer or recurring periods of low intakes, especially by persons with marginal intakes in garrison, could compromise nutritional status to the point of potentially impairing immune function, health, or performance. Such a scenario is not unlikely in women, given that large proportions of the women deploying may have less than optimal nutritional status. Garrison studies have found the diets of female soldiers to be potentially low for the same nutrients—protein, folate, calcium, magnesium, iron, and zinc—that were low during the current field study (19; Cline, unpublished data from Fort Polk). Furthermore, in one study, one-third of the female Army officers starting officer basic training at the Army Medical Department Center and School had serum ferritin values indicating low iron stores (4). This prevalence of iron deficiency was comparable to women in the general population and is likely comparable to the general female military population. Therefore, any depletion of nutrient stores during a period of field feeding may exacerbate an already existing deficiency and adversely impact performance and health.

Of great concern are the few individuals (5% to 10% of the groups, women and men) with intakes so low that nutritional status could quickly deteriorate. There were 4 individuals that at some point in the 7-day study period truly went an entire day without eating. Eighty five individuals endured 1 or more days on less than 1000 kcal; 82 subjects survived 1 or more days on less than 150 g carbohydrate. Nine subjects reported carbohydrate intakes less than 150 g on 4 or more days.

Despite field feeding policies, history has shown that packaged rations intended for limited time periods actually have been and still will be utilized repeatedly for prolonged periods (31; Information paper, SGRD-USM-B, 17 June 1991. Subject: Nutritional Adequacy of the Meal, Ready-to-Eat: The Soldiers Perspective). Because

maximum usage cannot be guaranteed, rations should be planned for almost indefinite subsistence.

CONCLUSIONS AND RECOMMENDATIONS

This study failed to demonstrate overwhelming or generalized gender-specific differences in nutrient intakes by soldiers consuming two versions of MREs, although there were obvious gender differences in food consumption patterns and the nutrient profiles of the most highly rated foods. Gender preferences may more significantly influence nutrient intakes as the number of menus and distinct menu items increases in future ration procurements. Within the constraints of the relatively limited food choices prescribed by current operational rations and the manner they usually are issued (little, if any, free choice), nutrient intakes of women and men will be dictated mostly by total energy intake.

The concepts tested in the Concept ration (specific breakfast, lunch, and dinner menus, as well as new easy-to-eat items) did enhance energy and carbohydrate intakes as intended. These concepts, in addition to the incorporation of high-carbohydrate items, should continue to be pursued. However, protein intakes in the Concept group were marginally adequate. Nutrients of particular concern for women and men are folate, calcium, magnesium, and zinc. Dietary fiber intakes also were much lower than desirable. Women consuming the current version of the ration were unable to achieve recommended intakes of iron. Further research and development into incorporating good sources of these nutrients or selectively fortifying ration components are needed.

It is recommended that nutrient densities be adjusted so that dietary allowance levels of intake could be achieved within an energy intake of 2000 kcal. This would meet the needs of most women and men. Based on the MDRIs in the revised AR 40-25, the recommended ration standards (i.e., minimum ration content) for the nutrients found to be most likely underconsumed are presented in Table 24.

Table 24. Recommended Nutrient Contents of Operational Rations.

Nutrient	**Recommendation**	
	Nutrient Density	**Ration Standard**
Folate	200 μg/1000 kcal	720 μg/3600 kcal
Vitamin B_6	0.65 mg/1000 kcal	2.34 μg/3600 kcal
Calcium	500 mg/1000 kcal	1800 μg/3600 kcal
Iron	7.5 mg/1000 kcal	27 μg/3600 kcal
Magnesium	160 mg/1000 kcal	575 μg/3600 kcal
Zinc	6 mg/1000 kcal	21.6 μg/3600 kcal

The results of this study demonstrate the positive impact fortification of widely consumed foods can make on nutrient intakes. Food selection data from this study and others should be used to determine which components are consumed by the greatest majority of individuals to warrant consideration for fortification. Even with fortification of select ration components, ration consumers will need education and information to help them make the best food choices to meet their nutrient needs within their calorie goals. To this end, the Nutrition Facts panels and other label information must be accurate. The finding that the MRE crackers from one manufacturer were not fortified with calcium and iron, as mandated in the military specification for this item, supports the need for at least periodic monitoring of the nutrient content of the rations procured. Efforts to make operational ration manufacturers provide complete nutritional profiles and to accurately label their products should continue to be pursued.

REFERENCES

1. Baker-Fulco, C. J. Overview of dietary intakes during military exercises. In: *Not Eating Enough: Overcoming Underconsumption of Military Operational Rations,* edited by B. M. Marriott. Washington, D.C.: National Academy Press, 1995, p. 121-146.

2. Calloway, D. H. Nitrogen balance of men with marginal intakes of protein and energy. *J Nutr.* 105: 914-923, 1975.

3. Champagne, C. M., W. H. Karge, H. R. Allen, A. D. Cline, and C. J. Baker-Fulco. Diet and coronary heart disease risk factors in students at the U.S. Army Sergeants Major Academy. *The FASEB J.* 12(4): A224, 1998.

4. Cline, A. D., J. F. Patton, W. J. Tharion, S. R. Strowman, C. M. Champagne, J. Arsenault, K. L. Reynolds, J. P. Warber, C. Baker-Fulco, J. Rood, R. T. Tulley, and H. R. Lieberman. *Assessment of the Relationship Between Iron Status, Dietary Intake, Performance, and Mood State of Female Army Officers in a Basic Training Population.* Natick, MA: USARIEM. Technical Report T98-24, September 1998.

5. Cohen, J. *Statistical Power Analysis for the Behavioral Sciences.* New York: Academic Press, 1969.

6. Coleman, E. J. Carbohydrate—The master fuel. In: *Nutrition for Sport & Exercise* (2nd *ed.*), edited by J. R. Berning and S. N. Steen. Gaithersburg, MD: Aspen Publishers, Inc., 1998, p. 21-44.

7. Committee on Military Nutrition Research (CMNR). *Report of Committee Activities, October 1, 1986 - September 30, 1987.* Washington, D.C.: National Academy Press, 1988.

8. Crim, M. C. and H. N. Munro. Proteins and amino acids. In: *Modern Nutrition in Health and Disease* (8th ed.), edited by M. E. Shils, J. A. Olson, and M. Shike. Philadelphia: Lea & Febiger, 1994, p. 3-35.

9. DeLany, J. P., D. A. Schoeller, R. W. Hoyt, E. W. Askew, and M. A. Sharp. Field use of $D_2{}^{18}O$ to measure energy expenditure of soldiers at different energy intakes. *J. Appl. Physiol.* 67: 1922-1929, 1989.

10. Departments of the Army, the Navy, and the Air Force, Headquarters. *Nutrition Allowances, Standards, and Education.* Washington, D.C. AR 40-25 (Naval Command Medical Instruction 10110.0, Air Force Regulation 160-95), 1985.

11. Departments of the Army, the Navy, and the Air Force, Headquarters. *Nutrition Standards and Education.* Washington, D.C. AR 40-25 (Naval Command Medical Instruction 10110.0, Air Force Regulation 160-95), 2001.

12. Edwards, J. S. A., E. W. Askew, N. King, C. S. Fulco, R. W. Hoyt, and J. P. DeLany. *An Assessment of the Nutritional Intake and Energy Expenditure of Unacclimatized U.S. Army Soldiers Living and Working at High Altitude.* Natick, MA: USARIEM. Technical Report T10-91, 1991.

13. Food and Drug Administration. Food standards: amendment of standards of identity for enriched grain products to require addition of folic acid. Fed. Regist. 61(44): 8781-8797, 1996.

14. Gregory, J. F. III. Do available food composition data for folate meet current research needs? In: *22nd National Nutrient Data Bank Conference Proceedings (April 17, 1998).* [online] Food and Nutrition Information Center. Http://www.nal.usda.gov/fnic/foodcomp/conf/NDBC22/index.html. [December 21, 2000].

15. IOM, Institute of Medicine. *Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride.* Washington, D.C.: National Academy Press, 1997.

16. IOM, Institute of Medicine. *Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline.* Washington, D.C.: National Academy Press, 1998.

17. IOM, Institute of Medicine. *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids.* Washington, D.C.: National Academy Press, 2000.

18. IOM, Institute of Medicine. *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc.* Washington, D.C.: National Academy Press, 2001.

19. King, N., J. Arsenault, S. Mutter, C. Champagne, T. C. Murphy, K. A. Westphal, and E. W. Askew. *Nutritional Intake of Female Soldiers during the U.S. Army Basic Combat Training.* Natick, MA: USARIEM. Technical Report T94-17, August 1994.

20. Klicka, M. V., N. King, P. T. Lavin, and E. W. Askew. Assessment of dietary intakes of cadets at the U.S. Military Academy at West Point. *J. Am. Coll. Nutr.* 15(3): 273-282, 1996.

21. Kramer. F. M. The physical eating situation. In: *Not Eating Enough: Overcoming Underconsumption of Military Operational Rations*, edited by B. M. Marriott. Washington, D.C.: National Academy Press, 1995, p. 319-339.

22. Kretsch, M. J., P. M. Conforti, and H. E. Sauberlich. *Nutrient Intake Evaluation of Male and Female Cadets at the United States Military Academy, West Point, New York.* Presidio of San Francisco: Letterman Army Institute of Research. Technical Report 218, April 1986.

23. Lester, L. S. , L. L. Lesher, M. Salomon, D. B. Engell, S. L. Dewey, J. L. Ward, C. Thomas, and J. Kalick. *Nutritional and hedonic consequences of consuming the Meal, Ready-to-Eat (MRE) VIII or the Soldier Enhancement Program (SEP) MRE.* Natick, MA: U.S. Army Natick Research, Development and Engineering Center. Technical Report TR-93/015, January 1993.

24. Marriott, B. M., editor. *Not Eating Enough: Overcoming Underconsumption of Military Operational Rations.* Washington, D.C.: National Academy Press, 1995.

25. Morgan, T. E., L. A. Hodgess, D. Schilling, R. W. Hoyt, E. J. Iwanyk, G. McAninch, T. C. Wells , R. W. Hubbard, and E. W. Askew. *A Comparison of the Meal, Ready-to-Eat, Ration, Cold Weather, and Ration, Lightweight Nutrient Intakes During Moderate Altitude Cold Weather Field Training Operations.* Natick, MA: USARIEM. Technical Report T5-89, November 1988.

26. Murray, R., and C. A. Horswill. Nutrient requirements for competitive sports. In: *Nutrition in Exercise and Sport* (3rd ed.), edited by I. Wolinsky. Boca Raton, FL: CRC Press, 1998, p. 521-558.

27. NRC (National Research Council). *Recommended Dietary Allowances, 10th ed. Report of the Subcommittee on the Tenth Edition of the RDAs, Food and Nutrition Board, Commision on Life Sciences.* Washington, D.C.: National Academy Press, 1989.

28. Popper, R., E. Hirsch, L. Lesher, D. Engell, B. Jezior, B. Bell, and W. Matthew. *Field Evaluation of Improved MRE, MRE VII, and MRE IV.* Natick, MA: U.S. Army Natick Research, Development, and Engineering Center. Technical Report TR-87/027, January 1987.

29. Rose R. W., C. J. Baker, W. Wisnaskas, J. S. A. Edwards, and M. S. Rose. *Dietary Assessment of U.S. Army Basic Trainees at Fort Jackson, South Carolina.* Natick, MA: USARIEM. Technical Report T6-89, January 1989.

30. Rose, M. S., P. C. Szlyk, R. P. Francesconi, L. S. Lester, L. Armstrong, W. Matthew, A. V. Cardello, R. D. Popper, I. Sils, G. Thomas, D. Schilling, and R. Whang. *Effectiveness and Acceptability of Nutrient Solutions in Enhancing Fluid Intake in the Heat.* Natick, MA: USARIEM. Technical Report T10-89, March 1989.

31. Samuels, J. P., R. P McDevitt, M. C. Bollman, W. Maclinn, L. M. Richardson, and L. G. Voss. *Ration Development (Operation Studies Number One and Volume 12 in A Report of Wartime Problems in Subsistence Research and Development.* Quartermaster Food & Container Institute for the Armed Forces. June 1947.

32. Schoeller, D. A. Measurement of energy expenditure in free-living humans by using doubly labeled water. *J. Nutr.* 118: 1278-1289, 1988.

33. Szeto, E. G., D. E. Carlson, T. B. Dugan, and J. C. Buchbinder. *A Comparison of Nutrient Intakes Between a Fort Riley Contractor-Operated and a Fort Lewis Military-Operated Garrison Dining Facility.* Natick, MA: USARIEM. Technical Report T2-88, October 1987.

34. Thomas, C. D., K. E. Friedl, M. Z. Mays, S. H. Mutter, R. J. Moore, D. A. Jezior, C. J. Baker-Fulco, L. J. Marchitelli, R. T. Tulley, and E. W. Askew. *Nutrient Intakes and Nutritional Status of Soldiers Consuming the Meal, Ready-to-Eat (MREXII) During a 30-day Field Training Exercise.* Natick, MA: USARIEM. Technical Report T95-6, January 1995.

35. Williams, M. H. *Nutrition for Health, Fitness & Sport* (5th Ed.). Boston: WCG/McGraw-Hill, 1999.

APPENDIX A: Ration Menus

Concept Ration

MRE XVII

This Page Intentionaly
Left Blank

NEW CONCEPT MRE MENUS

	1	2	3	4	5
BREAKFAST	Pocket Nacho Cheese	RCW Oatmeal Strawberry	Pocket Biscuit & Sausage	Cereal & Milk (Frosted Flks)	Dehyd Eggs & Ham
	Pineapple	Nutrigrain Cereal Bar	Pound Cake, Vanilla	Pouch Bread White	Ranchero Sauce
	Apple Toaster Pastry	Pears (No Bx)	Pineapple	Peaches	Chocolate E-bar
	Cocoa Beverage	Hooah Peanut Butter	Ergo Orange Beverage	Peanut Butter	Pineapple
	Ergo Orange Beverage	RCW Tea, Lemon	Cocoa Beverage	Jelly	Fig Bars
	Coffee	Ergo Orange Beverage	Coffee	Ergo Orange Beverage	Chuckles (Starch Jellies)
	Creamer	Coffee	Creamer	Cocoa Beverage	Ergo Orange Beverage
	Sugar	Creamer	Sugar	Coffee	Tea
	Tabasco Sauce	Sugar	Tabasco Sauce	Creamer	Coffee
				Sugar	Creamer
				Rehydration Bag	Sugar
LUNCH	Bumble Bee Tuna Salad	Pocket PB & Jelly Sandw	Chunky Chicken	Pocket Pepperoni	Pocket BBQ Chicken Sandw
	Pouch Bread White	Cheddar Goldfish	Pouch Bread White	Chicken Noodle Soup	Applesauce
	Potato Sticks	Dri Jack Beef Steak	Hooah Raspberry	Jelly	Chicken Ramen Ndl Soup
	Beef Jerky	Peaches	Mixed Fruit	MRE Crackers	M&M Mars Munch Bar
	Applesauce	Caramel Popcorn Bar	Lemon Poppy Cake	Pears	Apple Cider
	Hunt's Choco. Pudding	Lorna Doone Cookies	Apple Cider	Starch Jelly Candy	Lemon-lime Bev. Base
	Charms	RCW Tea, Lemon	Orange Beverage Base	RCW Tea, Lemon	Coffee
	RCW Tea, Lemon	Grape Beverage Base	Coffee	Cherry Beverage Base	Creamer
	Lemon-lime Bev. Base	Coffee	Creamer	Coffee	Sugar
	Coffee	Creamer	Sugar	Creamer	
	Creamer	Sugar	Tabasco Sauce	Sugar	
	Sugar			Rehydration Bag	
	Tabasco Sauce				
DINNER	Pasta Primavera Alfredo	Pork Chow Mein	Cheese Tortellini	Chicken Stew	Meatloaf W/ Onion Gravy
	Tomato & Herb Flat Bread	Chow Mein Noodles	Pouch Bread White	Buttered White Rice	Mexican Rice
	Keebler Cheese & Crackers	Mixed Fruit	Jalapeno Cheese	Mixed Fruit	Pouch Bread White
	Hooah Apple Cinnamon	Nab Cheese & PB Crackers	MRE Crackers, Vegetable	Plain Flat Bread	Jelly
	Pears	Choc Mint Pound Cake	Applesauce	Shortbread Cookie	MRE Crackers
	Apple Cider	Skittles	Choco. Cvd. Mint Cookie	Orange Beverage Base	Nutter Butter Pb Cookies
	Orange Beverage Base	Cherry Beverage Base	Cocoa Bev Powder	Tea	RCW Tea, Lemon
	Coffee	Tea	Lemon-lime Bev. Base	Coffee	Grape Beverage Base
	Creamer	Coffee	Coffee	Creamer	Coffee
	Sugar	Creamer	Creamer	Sugar	Creamer
	Tabasco Sauce	Sugar	Sugar	Tabasco Sauce	Sugar
		Tabasco Sauce	Tabasco Sauce		Tabasco Sauce

MRE XVII

Menu 1	~~Menu 2~~	Menu 3	Menu 4	Menu 5	Menu 6	Menu 7	Menu 8	Menu 9	Menu 10	Menu 11	Menu 12	Menu 13	~~Menu 14~~	Menu 15	Menu 16	Menu 17	Menu 18	Menu 19	Menu 20
Beef Steak	~~Pork chop/ Noodles~~	Chicken Stew	Ham Slices	Chicken w/ Noodles	Beef Franks	Pork Chow Mein	Chicken w/ Rice	Beef Stew	Chili Mac	Pasta w/ Veg	Cheese Tortel-lini	Pork w/ Rice	~~Chicken Parm w/ Cavatelli~~	Grilled Chicken	Tuna w/ Noodles	Beef Ravioli	Turkey w/ Pot/ gravy	Beef w/ mush	Spagh w/ Meat Sauce
Mexican Rice	~~Apple Sauce~~	Pine-apple	White Rice	Peaches	TS Fruit	Chow Mein Noodles			Pine-apple	Peaches	Apple Sauce	Apple Sauce	~~White Rice~~	Mexican Rice	TS Fruit	TS Fruit		White Rice	
Tavern Nuts	~~Pound Cake~~	Pound Cake	Pound Cake	Fig Bar	Potato Sticks	Choc cvd Cookie	Fudge Brownie	Choc cvd Cookie	Oatmeal Cookie Bar	Pretzels	Granola Bar	Tavern Nuts	~~Pound Cake~~	Pound Cake	Pound Cake	Fudge Brownie	Pound Cake	Corn Chips	Cheese Curls or Fig Bar
Peanut Butter	~~Cheese Spread~~	Jelly	Cheese Spread	Peanut Butter	Peanut Butter	Peanut Butter	Jalapeno Cheese Spread	Jalapeno Cheese Spread	Jam	Peanut Butter	Peanut Butter	Jalapeno Cheese Spread	~~Cheese Spread~~	Jelly	Peanut Butter	Cheese Spread	Peanut Butter	Peanut Butter	Peanut Butter
Cracker	~~Cracker~~	Cracker	Cracker	Cracker	Cracker	Cracker	Cracker	Cracker	Cracker	Cracker	Cracker	Cracker	~~Cracker~~	Cracker	Cracker	Cracker	Cracker	Cracker	Cracker
					Jolly Rancher Candy	Skittles	Charms	M & Ms		Peanut Brittle Bas	Fig Bar				Jolly Rancher	Beef Jerky	Charms or Jolly Rancher		Skittles
		Cocoa	Cocoa	Cocoa				Cocoa	Cocoa					Cocoa					Cocoa
Bev base w/sugar	~~Bev base w/sugar~~				Bev base w/sugar	Bev base w/sugar	Bev base w/sugar					Bev base w/sugar	~~Bev base w/sugar~~	Bev base w/sugar	Bev base w/sugar		Bev base w/sugar	Bev base w/sugar	
Hot Sce	~~Hot Sce~~	Hot Sce	Hot Sce	Hot Sce	Hot Sce	Hot Sce	Hot Sce	Hot Sce	Hot Sce	Hot Sce	Hot Sce	Hot Sce	~~Hot Sce~~	Hot Sce	Hot Sce	Hot Sce	Hot Sce	Hot Sce	Hot Sce
Spoon	~~Spoon~~	Spoon	Spoon	Spoon	Spoon	Spoon	Spoon	Spoon	Spoon	Spoon	Spoon	Spoon	~~Spoon~~	Spoon	Spoon	Spoon	Spoon	Spoon	Spoon
Acc Pk B	~~Acc Pk A~~	Acc Pk C	Acc Pk C	Acc Pk C	Acc Pk A	Acc Pk A	Acc Pk A	Acc Pk C	Acc Pk D	Acc Pk D	Acc Pk D	Acc Pk A	~~Acc Pk A~~	Acc Pk A	Acc Pk A	Acc Pk C	Acc Pk C	Acc Pk B	Acc Pk C
FRH	~~FRH~~	FRH	FRH	FRH	FRH	FRH	FRH	FRH	FRH	FRH	FRH	FRH	~~FRH~~	FRH	FRH	FRH	FRH	FRH	FRH

Case A = Menus 1 - 12 (Menu 2 replaced with Menu 13); Case B = Menus 9 - 20 (Menu 14 replaced with Menu 6)

Accessory Packet A: Coffee, Cream sub, Sugar, Salt, Gum, Matches, Tissue, Towelette

Accessory Packet B: Coffee, Cream Sub, Sugar, Salt, Gum Matches, Tissue, Towelette, Candy (Vanilla caramels, tootsie roll)

Accessory Packet C: Lemon Tea with Sugar, Salt, Gum, Matches, Tissue, Towelette

Accessory Packet D: Lemon Tea with Sugar, Apple Cider, Salt, Gum, Matches, Tissue, Towelette

APPENDIX B:
Food Composition Data Used for Analyses

Concept Ration

MRE XVII

Table B-1: Nutrient Values Used to Calculate Dietary Intakes for CONCEPT Items*.

Item	Gram Weight	Energy (Kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Cholesterol (mg)	Fiber (g)
ENTREES							
Cheese Tortellini	227	245	30.2	11.5	8.6	24	3.25
Chicken Stew	227	261	18.5	21.2	11.2	53	1.9
Chunky Chicken	110	240	4.0	18.0	16.0	80	0.0
Eggs and Ham	62.5	318	8.3	28.0	19.3	615	3.2
Meatloaf w/Onion Gravy	227	270	15.2	18.4	15.0	0	0.0
Pasta Primavera Alfredo	227	227	24.1	8.1	10.9	0♯	0.0
Pork Chow Mein	227	218	14.8	16.4	10.3	55	2.1
Tuna Salad	78	190	6.0	8.0	15.0	15	1.0
POCKET SANDWICHES							
BBQ Chicken Pocket	120	362	46.7	16.2	12.2	45	0.0
Nacho Cheese	120	394	41.8	19.3	16.6	0♯	0.0
Peanut Butter & Jelly	120	457	51.6	15.0	21.1	0	0.0
Pepperoni Pocket	120	387	40.8	16.3	17.6	0♯	0.0
SIDE DISHES & SNACKS							
Beef Stick	11.3	50	1.0	4.0	3.0	5	0.0
Cheddar Goldfish	30	151	17.5	3.0	7.6	4	0.7
Cheese & Crackers	40	185	23.1	4.6	9.2	0	0.4
Cheese & PB Crackers	40	185	23.1	4.6	9.2	0	0.4
Chicken Noodle Soup	59.5	229	33.6	10.3	5.9	45	1.2
Chow Mein Noodles	28	134	17.1	3.8	5.9	0	0.7
Crackers, MRE	38	172	26.4	3.7	5.5	0	1.3
Flat Bread, Plain	56	183	27.8	4.0	6.3	0	1.1
Flat Bread, Tomato & Herb	56	183	27.8	4.0	6.3	0	1.1
Frosted Flakes w/Milk	60	229	54.4	3.0	0.1	0	1.1
Oatmeal	70	260	54.0	6.0	3.0	0	
Potato Sticks	28	150	13.7	2.0	10.6	0	0.8
Pouch Bread, White	51	179	26.4	4.6	6.0	0	1.3
Ramen Noodles	79.4	280	58.4	8.7	1.3	0	2.1
Mexican Rice	114	158	29.9	3.7	2.7	0	1.7
Rice, White	114	210	31.7	3.5	7.7	0	0.8
SPREADS							
Cheese Spread, Jalapeno	43	171	0.7	5.5	16.5	42	0.0
Jelly	28	77	20.1	0.1	0.0	0	0.2
FRUIT							
Applesauce	128	88	22.8	0.4	0.1	0	1.5
Mixed Fruit	128	93	24.0	0.6	0.1	0	2.4
Peaches	128	102	26.2	0.7	0.1	0	2.2
Pears	128	98	25.5	0.3	0.1	0	3.8
Pineapple	128	91	23.5	0.5	0.1	0	1.2

*Nutrient values have been rounded for table presentation.

♯Nutrient data not available and could not be imputed.

Table B-1: Nutrient Values Used to Calculate Dietary Intakes for CONCEPT Items*.

Item	Gram Weight	Energy (Kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Cholesterol (mg)	Fiber (g)
SWEET SNACKS & DESSERTS							
Caramel Popcorn Bar	18	67.1	15.7	1.9	0.2	0	1.3
Choco Cvd. Mint Cookies	40	184	20.4	1.8	10.4	0	0.0
Chocolate E-Bar	54	213	34.8	9.1	4.2	0	2.4
Fig Bar, RCW	58	202	41.1	2.2	4.2	0	2.7
Hooah Bar, Apple Cinn.	65	260	50.0	3.0	5.0	0	1.0
Hooah Bar, Peanut Butter	65	260	43.0	6.0	7.0	0	2.0
Hooah Bar, Raspberry	65	250	49.0	3.0	5.0	0	1.0
Lorna Doone Cookies	15.7	78.8	10.1	1.0	3.8	3	0.3
Nutter Butter Cookies	54	258	31.8	5.2	12.7	1	1.0
Nutrigrain Cereal Bar	37	136	27.0	1.6	2.8	0	0.0
Pound Cakes							
Chocolate Mint	71	293	40.3	4.2	14.5	46	1.9
Lemon	71	308	41.2	3.4	14.5	63	0.0
Vanilla	71	307	40.3	3.5	14.9	57	0.0
Pudding, Chocolate	99.2	147	22.3	2.0	5.5	1	1.0
Shortbread Cookies	64	297	36.8	3.5	15.1	0	0.0
Toaster Pastry, Apple	104	420	76.0	4.0	10.0	0	2.0
CANDY							
Charms	105	28	2.0	0.0	0.0	0	1.0
Chuckles	57	220	56.4	0.0	0.0	0	0.0
Peanut Munch Bar	40.3	223	18.7	5.2	14.1	2	1.9
Skittles	61.5	249	55.8	0.1	2.7	0	0.0
BEVERAGES							
Apple Cider, MRE	17	67	16.9	0.0	0.0	0	0.0
Beverage Base, all flavors	34	132	33.9	0.0	0.0	0	0.0
Cocoa, MRE	43	179	31.1	3.0	6.1	2	1.7
Coffee, MRE	2	4	0.7	0.2	0.0	0	0.0
Earl Grey Tea		2.37	0.8	0.0	0.0	0	0.0
Ergo-Drink, Orange	46.7	172	43.0	0.0	0.0	0	0.0
Lemon Tea, MRE	17	67	16.7	0.1	0.0	0	0.0
CONDIMENTS							
Cream Substitute	4	22	2.2	0.2	1.4	0	0.0
Ranchero Sauce	113	71	14.2	2.8	5.0	0	0.0
Salt	4	0	0.0	0.0	0.0	0	0.0
Sugar	6	23	6.0	0.0	0.0	0	0.0
Tabasco Sauce	4	0	0.1	0.0	0.0	0	0.0
Gum	3	10	2.8	0.0	0.0	0	0.0

*Nutrient values have been rounded for table presentation.

♯Nutrient data not available and could not be imputed.

Table B-1: Nutrient Values Used to Calculate Dietary Intakes for CONCEPT Items*.

Item	VITAMINS A (µg RE)	B$_1$ (mg)	B$_2$ (mg)	Niacin (mg)	B$_6$ (mg)	Folate (µg)	B12 (µg)	C (mg)	E (mg)
ENTREES									
Cheese Tortellini	147	0.21	0.38	3.06	0.27	21.6	1.90	12.6	1.8
Chicken Stew	308	0.04	0.19	8.72	0.32	26.0	0.08	0.0	0.6
Chunky Chicken	0	0.01	0.76	3.74	0#	0#	0#	0.0	0#
Eggs and Ham	44	0.32	1.04	2.90	0.18	23.3	2.17	0#	0#
Meatloaf w/Onion Gravy	0#	3.59	0.35	3.38	0.11	22.7	1.30	0#	0#
Pasta Primavera Alfredo	42	0.10	0.18	1.76	0.09	22.7	0#	0#	0#
Pork Chow Mein	0	0.21	0.28	2.73	0.20	23.0	0.68	0.0	2.4
Tuna Salad	120	0.02	0.00	1.20	0.04	5.7	0.36	0.0	0#
POCKET SANDWICHES									
BBQ Chicken Pocket	35.00	0.24	0.31	6.30	0.12	15.40	0.53	0.00	0.00
Nacho Cheese	0.00	0.22	0.29	3.78	0.08	23.80	0#	0#	0#
Peanut Butter & Jelly	0.00	0.22	0.27	5.96	0.20	22.40	0.00	0#	0#
Pepperoni Pocket	0.00	0.26	0.06	0.80	0.02	10.40	0#	0.00	0.86
SIDE DISHES & SNACKS									
Beef Stick	0	0.01	0.06	0.99	0.01	1.0	0.36	0.0	0.1
Cheddar Goldfish	9	0.17	0.13	1.40	0.17	7.5	0.14	0.0	0.3
Cheese & Crackers	0	0.18	0.15	1.85	0.06	10.0	0.00	0.0	0.7
Cheese & PB Crackers	0	0.18	0.15	1.85	0.06	10.0	0.00	0.0	0.7
Chicken Noodle Soup	7	0.71	0.25	4.82	0.32	58.3	0.01	1.2	0.1
Chow Mein Noodles	0	0.18	0.11	1.23	0.04	5.0	0.00	0.0	0.1
Crackers, MRE	0	0.79	0.48	2.67	0.43	12.0	0.00	0.0	1.0
Flat Bread, Plain	0	0.30	0.17	0.86	0.00	5.9	0.00	0.0	0.0
Flat Bread, Tomato & Herb	0	0.30	0.17	0.86	0.00	5.9	0.00	0.0	0.0
Frosted Flakes w/Milk	476	0.78	0.90	10.60	1.08	212.0	0.00	31.8	0.2
Oatmeal	400	0.60	0.68	8.00	0.80	0.2	0.00	0.0	0.0
Potato Sticks	0	0.04	0.04	1.26	0.09	14.0	0.00	13.6	0.7
Pouch Bread, White	0	0.21	0.15	2.09	0.05	7.0	0.00	0.0	0.8
Ramen Noodles	18	0.30	0.24	2.77	0.03	6.9	0.00	0.0	0#
Mexican Rice	75	0.14	0.11	3.36	0.23	9.1	0.00	11.4	0.6
Rice, White	47	0.07	0.02	1.43	0.12	0.0	0.00	0.0	1.1
SPREADS									
Cheese Spread, Jalapeno	925	0.91	0.09	0.02	1.26	6.0	0.21	29.7	0.3
Jelly	1	0.00	0.01	0.01	0.01	0.3	0.00	0.3	0.0
FRUIT									
Applesauce	0	0.02	0.02	0.11	0.04	5.0	0.00	306.7	0.3
Mixed Fruit	25	0.02	0.02	0.43	0.04	3.3	0.00	24.5	0.9
Peaches	47	0.01	0.03	0.75	0.02	4.1	0.00	56.4	3.1
Pears	0	0.01	0.02	0.18	0.02	2.0	0.00	41.5	0.5
Pineapple	2	0.10	0.02	0.18	0.08	5.9	0.00	51.0	0.1

Table B-1: Nutrient Values Used to Calculate Dietary Intakes for CONCEPT Items*.

	VITAMINS								
Item	A (μg RE)	B_1 (mg)	B_2 (mg)	Niacin (mg)	B_6 (mg)	Folate (μg)	B12 (μg)	C (mg)	E (mg)
SWEET SNACKS & DESSERTS									
Caramel Popcorn Bar	0#	0#	0#	0#	0#	0#	0#	0.0	0#
Choco Cvd. Mint	0	0.08	0.09	0.69	0.01	2.9	0.00	0.0	0.2
Chocolate E-Bar	2	0.04	0.27	0.34	0.06	6.3	0.28	0.0	0.4
Fig Bar, RCW	2	0.09	0.13	1.08	0.04	5.8	0.01	0.1	0.4
Hooah Bar, Apple	0#	0.30	0.34	4.00	0.40	200.0	1.20	21.0	0#
Hooah Bar, Peanut	0#	0.30	0.34	4.00	0.40	200.0	1.20	21.0	0#
Hooah Bar, Raspberry	0#	0.30	0.34	4.00	0.40	200.0	1.20	21.0	0#
Lorna Doone Cookies	2	0.05	0.05	0.52	0.00	1.4	0.01	0.0	0.5
Nutter Butter Cookies	5	0.09	0.10	2.31	0.04	17.3	0.03	0.0	1.9
Nutrigrain Cereal Bar	227	0.37	0.41	5.00	0.52	111.0	0.00	0.0	0.0
Pound Cakes									
Chocolate. Mint	11	0.07	0.16	0.70	0.02	13.0	0.09	0.0	0.8
Lemon Poppy	20	0.18	0.12	1.27	0.02	9.5	0.33	0.0	0.1
Vanilla	28	0.03	0.06	0.29	0.04	7.0	0.11	0.0	0.9
Pudding, Chocolate	11	0.03	0.15	0.34	0.03	3.0	0.00	1.8	0#
Shortbread Cookies	38	0.28	0.16	1.43	0.01	3.3	0.00	0.0	0.5
Toaster Pastry, Apple	200	0.30	0.34	4.00	0.40	80.0	0.05	0.0	1.9
CANDY									
Chuckles	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
Charms	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
Peanut Munch Bar	6	0.05	0.06	2.36	0.07	28.8	0.06	0.3	0.0
Skittles	0	0.00	0.00	0.00	0#	0#	0#	41.1	0.0
BEVERAGES									
Apple Cider, MRE	0	0.00	0.01	0.00	0.00	0.2	0.00	26.5	0.0
Beverage Base, all flavors	0	0.00	0.01	0.00	0.00	0.2	0.00	37.9	0.0
Cocoa, MRE	990	1.10	0.16	0.20	1.38	5.0	0.22	49.8	0.4
Coffee, MRE	0	0.00	0.00	0.48	0.00	0.0	0.00	0.0	0.0
Earl Grey Tea	0	0.00	0.03	0.00	0.00	12.0	0.00	0.0	0#
Ergo-Drink, Orange	0	0.00	0.00	0.00	0.00	100.0	0.00	51.3	0.0
Lemon Tea, MRE	0	0.00	0.04	0.08	0.00	7.0	0.00	0.0	0.0
CONDIMENTS									
Cream Substitute	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
Ranchero Sauce	276	0.14	0.07	2.06	0#	0#	0#	64.5	0#
Salt, MRE	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
Sugar	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
Tabasco Sauce	15	0.00	0.00	0.01	0.01	0.0	0.00	0.0	0.0

*Nutrient values have been rounded for table presentation.

#Nutrient data not available and could not be imputed.

Table B-1: Nutrient Values Used to Calculate Dietary Intakes for CONCEPT Items*.

Item	MINERALS						
	Calcium (mg)	Iron (mg)	Magnesium (mg)	Phosphorus (mg)	Potassium (mg)	Sodium (mg)	Zinc (mg)
ENTREES							
Cheese Tortellini	284.0	1.36	45.6	263	497	751	1.57
Chicken Stew	39.0	1.34	38.0	281	510	677	1.41
Chunky Chicken	0.0	1.44	0[#]	0[#]	170	940	0[#]
Eggs and Ham	81.1	2.37	28.7	0[#]	313	1250	2.19
Meatloaf w/Onion Gravy	56.8	2.72	40.9	0[#]	386	976	2.95
Pasta Primavera Alfredo	54.5	1.97	40.9	0[#]	295	908	1.54
Pork Chow Mein	31.0	1.22	28.0	154	383	1115	2.35
Tuna Salad	0.0	0.72	14.8	0	139	270	0.44
POCKET SANDWICHES							
BBQ Chicken Pocket	74	2.40	34.8	0	324	912	0.88
Nacho Cheese	58	2.76	30.0	0[#]	168	1104	2.04
Peanut Butter & Jelly	71	2.28	66.0	0[#]	300	504	1.32
Pepperoni Pocket	85	2.32	23.6	75	81	1175	1.36
SIDE DISHES & SNACKS							
Beef Stick	1.5	0.61	4.9	41	77	270	0.82
Cheddar Goldfish	45.3	1.43	10.8	65	44	299	0.34
Cheese & Crackers	35.2	1.11	20.8	122	85	385	0.40
Cheese & PB Crackers	35.2	1.11	20.8	122	85	385	0.40
Chicken Noodle Soup	28.6	2.03	26.0	126	122	2054	0.78
Chow Mein Noodles	6.0	1.17	14.0	50	46	187	0.31
Crackers, MRE	228.0	1.91	11.0	46	60	154	0.42
Flat Bread, Plain	7.2	1.34	0.4	36	38	270	0.08
Flat Bread, Tomato & Herb	7.2	1.34	40.9	36	38	270	0.08
Frosted Flakes w/Milk	2.4	3.78	4.8	44	38	486	0.08
Oatmeal	200.0	7.20	0.0	200	0	280	0.00
Potato Sticks	4.0	0.46	17.0	40	367	134	0.30
Pouch Bread, White	75.0	1.64	13.0	53	67	313	0.38
Ramen Noodles	25.8	2.88	22.5	53	120	1736	0.39
Mexican Rice	53.6	0.76	19.4	97	187	415	0.36
Rice, White	5.7	0.23	4.6	46	41	611	0.70
SPREADS							
Cheese Spread, Jalapeno	179.0	0.18	7.0	287	24	578	0.81
Jelly	2.3	0.06	1.7	1	18	10	0.01
FRUIT							
Applesauce	4.0	0.52	4.0	8	80	25	0.12
Mixed Fruit	8.7	0.58	7.2	12	99	19	0.20
Peaches	5.1	0.45	6.7	12	107	17	0.11
Pears	9.0	0.57	7.0	10	71	16	0.16
Pineapple	14.4	0.60	14.0	8	93	26	0.18

Table B-1: Nutrient Values Used to Calculate Dietary Intakes for CONCEPT Items*.

Item	MINERALS						
	Calcium (mg)	Iron (mg)	Magnesium (mg)	Phosphorus (mg)	Potassium (mg)	Sodium (mg)	Zinc (mg)
SWEET SNACKS & DESSERTS							
Caramel Popcorn Bar	4.4	0.14	0#	0#	0#	32	0#
Choco Cvd. Mint	7.5	1.01	18.4	42	76	53	0.29
Chocolate E-Bar	125.0	2.50	42.3	153	253	106	0.96
Fig Bar, RCW	37.1	1.68	15.7	36	120	203	0.23
Hooah Bar, Apple	40.0	0#	24.0	60	30	70	0#
Hooah Bar, Peanut	20.0	0.72	0#	80	170	35	0.30
Hooah Bar, Raspberry	40.0	0.36	24.0	60	40	80	0#
Lorna Doone Cookies	5.5	0.43	2.7	17	16	71	0.08
Nutter Butter Cookies	18.9	1.36	24.3	46	90	224	0.29
Nutrigrain Cereal Bar	15.2	1.80	38.1	38	73	110	1.52
Pound Cakes							
Chocolate. Mint	25.0	3.22	45.0	87	151	115	0.83
Lemon Poppy	45.2	0#	4.8	56	59	139	0.30
Vanilla	13.0	0.43	7.0	52	45	127	0.48
Pudding, Chocolate	54.2	0.54	20.8	79	179	152	0.42
Shortbread Cookies	6.2	1.80	2.8	31	34	84	0.10
Toaster Pastry, Apple	0.0	3.60	0#	79	116	340	0.60
CANDY							
Chuckles	1.7	0.23	0.6	1	3	25	0.00
Charms	5.0	0.03	0.0	0	1	2	0.04
Peanut Munch Bar	39.6	0.45	34.4	82	161	107	0.62
Skittles	0.1	0.00	0#	0#	0	10	0#
BEVERAGES							
Apple Cider, MRE	23.6	0.06	0.3	13	1	1	0.01
Beverage Base, all	6.4	0.08	0.4	4	2	15	0.04
Cocoa, MRE	65.0	0.85	29.0	156	401	130	0.38
Coffee, MRE	2.0	0.07	6.0	5	60	1	0.01
Earl Grey Tea	0.0	0.05	8.0	2	88	8	0.05
Ergo-Drink, Orange	439.0	0.42	57.8	200	194	17	0.47
Lemon Tea, MRE	0.5	0.05	1.5	3	43	3	0.02
CONDIMENTS							
Cream Substitute	1.0	0.03	0.0	18	41	7	0.00
Ranchero Sauce	29.8	1.98	0#	66	617	787	0.00
Salt, MRE	1.0	0.00	0.1	0	0	1550	0.00
Sugar	0.0	0.00	0.0	0	0	0	0.00
Tabasco Sauce	1.0	0.06	0.0	1	4	22	0.00

*Nutrient values have been rounded for table presentation.
#Nutrient data not available and could not be imputed.

Table B-2: Nutrient Values Used to Calculate Dietary Intakes for MRE XVII Items*.

Item	Gram Weight	Energy (Kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Saturated fat (g)	MFA (g)	PUFA (g)	Cholesterol (mg)	Fiber (g)
ENTREES										
Beef Franks	113	288	3.0	16.7	22.8	10.5	9.5	0.5	75	0.0
Beef Ravioli	227	288	36.2	9.4	11.7	4.4	4.3	0.5	20	2.0
Beef Steak	128	240	0.0	27.9	13.4	4.5	5.2	0.6	83	0.0
Beef Stew	227	242	12.6	27.7	8.5	2.8	3.4	0.9	62	1.8
Beef w/Mushrooms	227	312	11.4	27.9	16.9	7.2	6.3	0.9	86	1.6
Cheese Tortellini	227	233	37.6	9.0	5.4	2.0	1.3	1.5	8	3.0
Chicken Stew	227	261	18.5	21.2	11.2	3.6	4.8	1.7	53	1.9
Chicken w/Noodles	227	240	19.0	27.0	6.0	2.0	0.0	0.0	75	3.0
Chicken w/Rice	227	283	10.5	34.2	10.6	2.6	4.8	2.3	83	0.0
Chili Macaroni	227	270	22.5	22.9	9.7	3.7	4.2	0.7	52	3.3
Grilled Chicken Breast	79	123	1.6	16.5	5.7	1.2	1.7	0.8	53	0.0
Ham Slice	128	163	0.1	26.4	5.5	1.8	2.7	0.5	83	0.0
Pasta w/Vegetables	227	207	42.6	7.6	0.6	0.0	0.0	0.0	0	5.7
Pork Chow Mein	227	218	14.8	16.4	10.3	3.3	3.9	2.4	55	2.1
Pork w/Rice	227	377	20.1	34.5	17.4	5.9	7.8	2.0	83	2.0
Spaghetti w/Meat Sauce	227	263	24.6	21.6	8.8	3.6	3.6	0.4	38	2.3
Tuna w/Noodles	227	230	19.6	18.2	8.5	2.4	2.8	2.7	47	1.7
Turkey Breast w/Potatoes	227	210	16.3	22.3	6.0	1.5	0.0	0.0	65	1.0
SIDE DISHES & SNACKS										
Beef Stick	23	65	0.4	7.9	3.4	1.3	1.4	0.2	25	0.0
Chow Mein Noodles	28	134	17.1	3.8	5.9	1.0	3.4	0.9	0	0.7
Corn Chips	28.4	153	16.1	1.9	9.5	1.3	2.7	4.7	0	1.4
Crackers	38	172	26.4	3.7	5.5	1.2	3.3	0.6	0	1.3
Potato Sticks	28	150	13.7	2.0	10.6	2.8	5.9	1.4	0	0.8
Pretzel Sticks	28.4	108	22.5	2.6	1.0	0.2	0.4	0.4	0	0.9
Rice, Mexican	142	194	35.6	4.4	3.9	0.7	0.9	2.0	0	2.1
Rice, White	142	243	34.2	4.4	9.6	2.0	4.1	2.9	0	1.0
Tavern Nuts	28	176	6.1	7.4	13.0	1.8	6.4	4.1	0	2.6
SPREADS										
Cheese Spread	46	183	0.7	5.9	17.7	10.3	5.6	0.8	45	0.0
Cheese Spread, Jalapeno	43	171	0.7	5.5	16.5	9.7	5.2	0.7	42	0.0
Jelly	28	77	20.1	0.1	0.0	0.0	0.0	0.0	0	0.2
Peanut Butter	43	248	7.6	11.8	21.0	3.7	9.4	6.8	0	2.8

*Nutrient values have been rounded for table presentation.

Table B-2: Nutrient Values Used to Calculate Dietary Intakes for MRE XVII Items*.

Item	Gram Weight	Energy (Kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Saturated fat (g)	MFA (g)	PUFA (g)	Cholesterol (mg)	Fiber (g)
FRUIT										
Applesauce	128	88	22.8	0.4	0.1	0.0	0.0	0.0	0	1.5
Mixed Fruit	128	93	24.0	0.6	0.1	0.0	0.0	0.0	0	2.4
Peaches	128	102	26.2	0.7	0.1	0.0	0.0	0.0	0	2.2
Pineapple	128	91	23.5	0.5	0.1	0.0	0.0	0.0	0	1.2
SWEET SNACKS & DESSERTS										
Chocolate Covered Cookie	46	234	28.5	3.2	12.8	7.6	3.6	0.8	12	1.4
Fig Bar	54	198	40.4	2.1	4.2	0.8	2.3	0.7	0	2.6
Fudge Brownie	85	340	44.7	4.6	18.1	6.4	9.4	1.3	41	1.9
Granola Bar	45	199	32.0	4.7	6.3	0.8	3.6	1.3	0	2.5
Oatmeal Cookie Bar	55	259	37.3	4.0	10.8	3.0	6.2	1.0	16	1.8
Pound Cakes										
Chocolate Mint	71	293	40.3	4.2	14.5	5.0	7.1	1.6	46	1.9
Lemon	71	303	40.6	3.8	14.2	4.0	7.6	1.8	61	0.0
Pineapple	71	305	40.9	3.6	14.3	4.0	7.7	1.8	58	0.0
Vanilla	71	307	40.3	3.5	14.9	4.1	8.0	2.0	57	0.0
CANDY										
Caramels	35	147	27.1	1.1	4.6	4.2	0.1	0.0	0	0.0
Charms	28	105	27.6	0.0	0.0	0.0	0.0	0.0	0	0.0
Jolly Rancher Candies	45	169	44.4	0.0	0.0	0.0	0.0	0.0	0	0.0
M&Ms	43	202	29.2	2.7	9.3	5.5	3.0	0.4	7	1.3
Peanut Munch Bar	40	223	18.7	5.2	14.1	3.5	6.8	3.3	2	1.6
Skittles	61.5	250	55.8	0.1	2.7	0.5	1.8	0.1	0	0.0
Tootsie Roll	28	115	23.2	0.4	2.9	0.6	1.8	0.2	1	0.6
BEVERAGES										
Apple Cider	21	85	20.6	0.0	0.2	0.0	0.0	0.0	0	0.0
Beverage Base, all flavors	34	132	33.9	0.0	0.0	0.0	0.0	0.0	0	0.0
Cocoa	43	179	31.1	3.0	6.1	2.9	2.7	0.2	2	1.7
Coffee	2	4	0.7	0.2	0.0	0.0	0.0	0.0	0	0.0
Lemon Tea	18.6	72	18.2	0.1	0.1	0.0	0.0	0.0	0	0.0
CONDIMENTS										
Cream Substitute	4	22	2.2	0.2	1.4	0.5	0.8	0.0	0	0.0
Sugar	6	23	6.0	0.0	0.0	0.0	0.0	0.0	0	0.0
Salt	4	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0
Gum	3	10	2.8	0.0	0.0	0.0	0.0	0.0	0	0.0
Tabasco Sauce	4	0	0.1	0.0	0.0	0.0	0.0	0.0	0	0.0

*Nutrient values have been rounded for table presentation.

Table B-2: Nutrient Values Used to Calculate Dietary Intakes for MRE XVII Items*.

	VITAMINS									
Item	A (mcg RE)	Carotene (RE)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	B6 (mg)	Folate (μg)	B12 (μg)	C (mg)	E (mg)
ENTREES										
Beef Franks	0	0	0.03	0.18	4.56	0.05	3.7	1.13	0.0	0.3
Beef Ravioli	85	0	0.13	0.27	2.13	0.59	78.2	1.51	9.5	2.0
Beef Steak	0	0	0.05	0.28	5.24	0.16	16.9	4.46	0.0	0.1
Beef Stew	333	332	0.07	0.24	6.30	0.41	29.0	1.63	0.0	2.1
Beef w/Mushrooms	0	0	0.18	0.24	4.67	0.44	24.0	2.78	0.0	0.4
Cheese Tortellini	66	49	0.24	0.23	2.51	0.12	32.0	0.09	0.0	0.9
Chicken Stew	308	308	0.04	0.19	8.72	0.32	26.3	0.79	0.0	0.6
Chicken w/Rice	0	0	0.06	0.19	9.55	0.28	16.3	0.50	0.0	1.0
Chicken w/Noodles	428	0	0.15	0.15	5.50	0.43	121.0	1.28	9.0	1.8
Chili Macaroni	107	107	0.13	0.39	6.09	0.34	65.2	1.86	0.0	1.5
Grilled Chicken Breast	50	0	0.06	0.09	10.90	0.47	2.8	0.27	0.0	0.4
Ham Slice	0	0	0.30	0.28	6.09	0.25	7.5	0.64	0.0	0.4
Pasta w/Vegetables	306	306	0.16	0.20	3.23	0.17	18.6	0.00	5.7	17.7
Pork Chow Mein	0	0	0.21	0.28	2.73	0.20	23.0	0.68	0.0	2.4
Pork w/Rice	59	56	0.34	0.31	5.93	0.30	23.6	1.33	0.0	2.4
Spaghetti w/Meat Sauce	87	87	0.14	0.27	5.32	0.28	88.1	1.23	0.0	1.9
Tuna w/Noodles	49	49	0.20	0.22	8.75	0.15	10.3	2.78	0.0	1.3
Turkey Breast w/Potatoes	20	0	0.07	0.12	6.74	0.55	7.8	0.33	2.1	0.2
SIDE DISHES & SNACKS										
Beef Stick	0	0	~0.00	0.12	2.01	0.03	2.0	0.74	0.0	0.2
Chow Mein Noodles	0	0	0.18	0.11	1.23	0.04	4.5	0.00	0.0	0.1
Corn Chips	3	3	0.01	0.04	0.34	0.07	5.7	0.00	0.0	0.4
Crackers	0	0	0.79	0.48	2.67	0.43	12.2	0.00	0.0	1.0
Potato Sticks	0	0	0.04	0.04	1.26	0.09	14.2	0.00	13.6	0.7
Pretzel Sticks	0	0	0.13	0.18	1.50	0.03	23.5	0.00	0.0	0.1
Rice, Mexican	47	47	0.18	0.14	4.18	0.29	13.0	0.00	14.2	0.4
Rice, White	72	8	0.08	0.02	1.78	0.15	6.0	0.00	0.0	1.4
Tavern Nuts	0	0	0.06	0.03	3.61	0.04	21.6	0.00	0.0	2.1
SPREADS										
Cheese Spread	991	0	0.97	0.10	0.02	1.35	6.2	0.23	31.8	0.3
Cheese Spread, Jalapeno	925	0	0.91	0.09	0.02	1.26	6.0	0.21	29.7	0.3
Jelly	1	~0	0.00	0.01	0.01	0.01	0.3	0.00	0.3	0.0
Peanut Butter	679	0	0.97	0.05	5.50	1.60	21.1	0.00	34.9	3.8

*Nutrient values have been rounded for table presentation.

Table B-2: Nutrient Values Used to Calculate Dietary Intakes for MRE XVII Items*.

Item	VITAMINS									
	A (mcg RE)	Carotene (RE)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	B6 (mg)	Folate (μg)	B12 (μg)	C (mg)	E (mg)
FRUIT										
Applesauce	0	0	0.02	0.02	0.11	0.04	5.0	0.00	306.7	0.3
Mixed Fruit	25	25	0.02	0.02	0.43	0.04	3.3	0.00	24.5	0.9
Peaches	47	47	0.01	0.03	0.75	0.02	4.1	0.00	56.4	3.1
Pineapple	2	2	0.10	0.02	0.18	0.08	5.9	0.00	51.0	0.1
SWEET SNACKS & DESSERTS										
Chocolate Covered Cookie	203	0	0.46	0.08	0.26	0.31	7.0	0.11	2.3	0.8
Fig Bar	2	2	0.09	0.12	1.07	0.04	5.7	0.01	0.1	0.4
Fudge Brownie	19	0	0.10	0.21	0.89	0.01	13.0	0.00	0.0	2.1
Granola Bar	7	7	0.10	0.08	0.50	0.03	5.0	0.00	0.0	1.6
Oatmeal Cookie Bar	0	0	0.11	0.05	0.48	0.02	9.3	0.00	0.0	1.4
Pound Cakes										
Chocolate Mint	11	0	0.07	0.16	0.70	0.02	38.2	0.09	0.0	0.8
Lemon	37	0	0.09	0.14	0.92	0.05	32.3	0.11	0.0	1.1
Pineapple	30	0	0.09	0.14	0.92	0.03	32.2	0.11	0.0	0.9
Vanilla	28	0	0.09	0.14	0.92	0.04	32.1	0.11	0.0	0.9
CANDY										
Caramels	0	0	0.01	0.05	0.10	0.01	1.0	0.00	0.0	0.1
Charms			0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
Jolly Rancher Candies	0	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
M&Ms	0	0	0.03	0.12	0.24	0.01	5.4	0.17	0.0	0.4
Peanut Munch Bar	6	6	0.05	0.06	2.36	0.07	28.8	0.06	0.3	0.0
Skittles	0	0	~0.00	0.01	0.01	~0.00	0.0	0.00	41.1	0.2
Tootsie Roll	0	0	0.01	0.03	0.05	0.01	2.3	0.00	0.0	0.3
BEVERAGES										
Apple Cider	0	0	0.00	0.00	0.00	0.00	0.0	0.00	50.4	0.0
Beverage Base, all flavors	~0	~0	0.00	0.01	0.00	0.00	0.2	0.00	37.9	0.0
Cocoa	990	0	1.10	0.16	0.20	1.38	5.3	0.22	49.8	0.4
Coffee	0	0	0.00	0.00	0.48	0.00	0.0	0.00	0.0	0.0
Lemon Tea	0	0	0.00	0.04	0.08	~0.00	7.9	0.00	15.0	0.0
CONDIMENTS										
Cream Substitute	0	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	~0.0
Sugar	0	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
Salt	0	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
Gum	0	0	0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.0
Tabasco Sauce	15	15	0.00	0.00	0.01	0.01	0.1	0.00	0.0	~0.0

*Nutrient values have been rounded for table presentation.

Table B-2: Nutrient Values Used to Calculate Dietary Intakes for MRE XVII Items*.

Item	MINERALS							
	Calcium (mg)	Copper (mg)	Iron (mg)	Magnesium (mg)	Phosphorus (mg)	Potassium (mg)	Sodium (mg)	Zinc (mg)
ENTREES								
Beef Franks	19.0	0.11	2.48	17.0	290	236	1172	4.62
Beef Ravioli	64.0	0.00	2.75	101.0	336	384	1480	3.78
Beef Steak	7.1	0.15	3.15	32.5	344	452	504	6.93
Beef Stew	24.0	0.26	3.05	38.0	221	544	877	4.51
Beef w/Mushrooms	57.0	0.23	3.52	39.0	299	501	891	6.26
Cheese Tortellini	120.0	0.20	2.22	34.0	134	277	1070	0.98
Chicken Stew	39.2	0.24	1.34	38.5	281	510	677	1.41
Chicken w/Noodles	37.9	0.00	1.66	29.5	115	371	860	1.37
Chicken w/Rice	18.3	0.26	2.09	33.8	338	279	697	2.38
Chili Macaroni	39.4	0.30	3.67	48.2	260	619	939	4.30
Grilled Chicken Breast	11.9	0.04	0.82	23.0	180	202	499	0.79
Ham Slice	6.4	0.19	1.48	28.4	378	416	1323	2.96
Pasta w/Vegetables	59.0	0.28	1.93	45.4	123	813	1200	1.11
Pork Chow Mein	31.1	0.36	1.22	28.3	154	384	1115	2.35
Pork w/Rice	33.4	0.29	2.81	44.3	260	681	1020	3.66
Spaghetti w/Meat Sauce	79.9	0.34	3.64	47.6	204	606	1098	3.66
Tuna w/Noodles	56.0	0.23	2.16	33.1	218	198	672	1.21
Turkey Breast w/Potatoes	20.2	0.00	1.3	35.2	316	388	1103	1.20
SIDE DISHES & SNACKS								
Beef Stick	3.0	0.02	0.82	10.0	84	157	612	1.66
Chow Mein Noodles	5.8	0.06	1.17	14.3	50	46	187	0.31
Corn Chips	36.0	0.05	0.374	21.6	52	40	179	0.36
Crackers	106.7	0.08	1.91	11.1	46	60	154	0.42
Potato Sticks	4.3	0.08	0.46	16.8	40	367	134	0.30
Pretzel Sticks	10.2	0.08	1.23	9.9	32	41	486	0.24
Rice, Mexican	66.0	0.11	0.95	24.0	120	232	516	0.45
Rice, White	7.0	0.07	0.28	6.0	56	51	760	0.86
Tavern Nuts	14.7	0.37	0.591	47.4	81	152	66	0.80
SPREADS								
Cheese Spread	192.1	0.06	0.19	7.0	307	26	619	0.87
Cheese Spread, Jalapeno	179.0	0.06	0.18	7.0	287	24	578	0.81
Jelly	2.3	0.01	0.06	1.7	1	18	10	0.01
Peanut Butter	21.1	0.22	0.77	74.1	157	273	232	1.11

Table B-2: Nutrient Values Used to Calculate Dietary Intakes for MRE XVII Items*.

Item	MINERALS							
	Calcium (mg)	Copper (mg)	Iron (mg)	Magnesium (mg)	Phosphorus (mg)	Potassium (mg)	Sodium (mg)	Zinc (mg)
FRUIT								
Applesauce	4.0	0.13	0.52	4.0	8	80	25	0.12
Mixed Fruit	8.7	0.06	0.58	7.2	12	99	19	0.20
Peaches	5.1	0.04	0.45	6.7	12	107	17	0.11
Pineapple	14.4	0.20	0.60	14.0	8	93	26	0.18
SWEET SNACKS & DESSERTS								
Chocolate Covered Cookie	34.9	0.13	0.97	25.4	81	106	82	0.54
Fig Bar	36.5	0.08	1.65	15.4	35	118	200	0.22
Fudge Brownie	21.0	0.39	2.21	41.8	141	215	128	0.95
Granola Bar	17.0	0.10	1.12	40.0	128	117	133	0.92
Oatmeal Cookie Bar	14.4	0.80	3.37	61.0	99	91	171	2.80
Pound Cakes								
Chocolate Mint	25.5	0.25	3.22	44.6	87	151	115	0.83
Lemon	14.3	0.24	1.56	7.4	52	47	139	0.53
Pineapple	13.8	0.22	1.56	6.1	53	45	132	0.43
Vanilla	12.8	0.30	1.56	6.8	52	45	127	0.48
CANDY								
Caramels	36.0	0.05	0.21	4.1	34	52	142	0.18
Charms	4.6	0.00	0.03	0.0	0	1	2	0.04
Jolly Rancher Candies	7.3	0.06	0.05	0.7	~0	1	4	0.06
M&Ms	74.6	0.20	0.59	24.2	83	128	32	0.51
Peanut Munch Bar	39.6	0.19	0.45	34.4	82	161	107	0.62
Skittles	0.0	0.03	0.01	0.6	1	3	10	0.02
Tootsie Roll	14.0	0.06	1.68	7.2	21	43	28	0.14
BEVERAGES								
Apple Cider	39.1	0.00	0.07	0.8	16	1	1	0.00
Beverage Base, all flavors	6.4	0.04	0.08	0.4	4	2	15	0.04
Cocoa	64.5	0.18	0.85	29.3	156	401	130	0.38
Coffee	2.4	0.00	0.07	5.6	5	60	1	0.01
Lemon Tea	0.6	0.01	0.03	2.1	3	40	1	0.02
CONDIMENTS								
Cream Substitute	1.3	0.00	0.03	0.2	18	41	7	0.00
Sugar	0.1	0.00	0.00	0.0	~0	~0	~0	0.00
Salt	1.0	0.00	0.00	0.1	0	~0	1550	0.00
Gum	0.0	0.00	0.00	0.0	0	~0	~0	0.00
Tabasco Sauce	0.6	0.01	0.06	0.4	1	4	22	0.00

*Nutrient values have been rounded for table presentation.